LAQ'S (8 MARKS)

WAVES

1. Explain the formation fo stationary waves in stretched strings and hence deduce the laws of transverse waves in stretched strings.

A. **Stationary wave:** The interference of two idnetical waves moving in opposite directions produces stationary waves.

It forms nodes when the displacement is O and antinodes when the displacement is maximum

$y_1 = A \sin (wt - kx)$

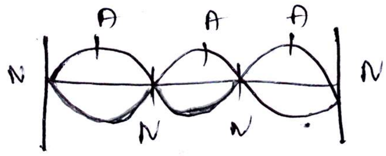
$y_2 = A \sin (wt + kx)$

$y = y_1 + y_2$

$y = A \sin (wt + kx) + A \sin (wt + kx)$

$y = 2A \sin kx \quad \cos wt$

$y = a_m \cos wt, \quad a_m = 2a \sin kx$



→ It forms alternate nodes and antinodes.

→ If amplitude is zero, it gives node.

→ If amoplitudes is maximum if gives antinode.

→ The distance between N-N (or) A -A = $\lambda/2$.

→ The distance between A-N (or) N-A = $\lambda/4$.

→ The position of nodes kx $\; n\pi$ (n = 0, 1, 2, ...)

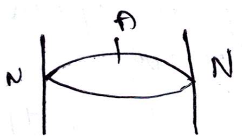
→ The position of antinode kx = $\left(n + \frac{1}{2}\right)\pi$ (n = 0, 1, 2, ...)

Modes of Vibrationin a stretched string:

→ We know that velocity of transverse wave is a stretchede string is $\sqrt{\frac{7}{\mu}}$

Fundametnal Frequency:

→ It is the lowest possible natural frequency of stationary wave is called fundamental frequency or first harmonic.



$n_1 = \sqrt{\frac{T}{\mu}}$

$= v/\lambda$

$n_1 = \frac{V}{\lambda}$ $\qquad \ell = \lambda/2$

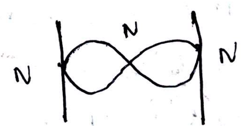
$n_1 = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ $\qquad \lambda = 2\ell$

$n_1 = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$.

First overtone:

→ If the frequency is more than fundamental frequency are called overtone.

$n_2 = \frac{\frac{1}{2l}\sqrt{\frac{T}{\mu}}}{2}$

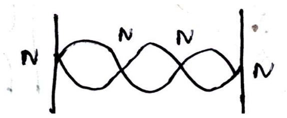


$n_2 = 2\frac{1}{2\ell}\sqrt{\frac{7}{\mu}}$ $\qquad \ell = 2\lambda / 2$

$n_2 = 2n_1$ $\qquad \lambda = 2\ell / 2$

Second Overtone:

$$n_3 = 3\left[\frac{1}{2\ell}\sqrt{\frac{7}{\mu}}\right]$$



$n_1 : n_2 : n_3 = 1 : 2 : 3$ $\qquad$ $\ell = 3\lambda/2$

Law of Transverse wave in a Stretched String:

$$n = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$$

I Law : $n \propto \frac{1}{\ell}$ [7 & μ are constant]

$n_1\ell_1 = n_2\ell_2$

II Law : $n \propto \sqrt{T}$

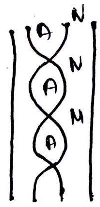
$\frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$ [ℓ & μ are constant]

III Law : $n \propto \frac{1}{\sqrt{\mu}}$

$n_1\sqrt{\mu_1} = n_2\sqrt{\mu_2}$ [ℓ & T are constant]

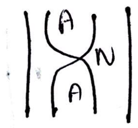
2. **Explain the formation of stationary waves in an air column unclosed in open pipe. Derive the equation for the frequencies of the harmonics produced.**

A. If the pipe is open at both the ends is called open pipe.
$n = V/\lambda$



Fundamental Frequency :

$$n_1 = \frac{V}{2\ell}$$

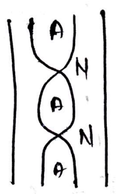


$\ell = \lambda / 2$

$\lambda = 2\ell$

First overtone :

$$n_2 = \frac{V}{\frac{2\ell}{2}}$$



$\ell = 2\lambda / 2$

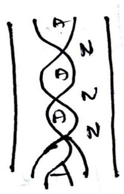
$$n_2 = \frac{2V}{2\ell}$$

$\lambda = 2\ell / 2$

$\therefore n_2 = 2n_1$

Second overtone:

$$n_3 = \frac{V}{\frac{2\ell}{3}}$$



$\ell = \frac{3\lambda}{2}$

$$n_3 = \frac{3V}{2\ell}$$

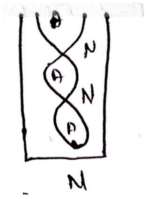
$\lambda = \frac{2\ell}{3}$

$n_3 = 3n_1$

$n_1 : n_2 : n_3 \;\; 1 : 2 : 3.$

3. How are stationary waves formed in closed pipes? Expalin the various modes of vibrations and obtain relations for thier frequencies?

A. If the pipe is closed at one end is called closed pipe.



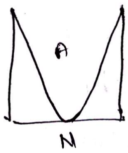
$$v = n\lambda$$

$$n = \frac{V}{\lambda}$$

Fundamental frequency:

It consists of one antinode and one node

$$n_1 = \frac{V}{4\ell}$$



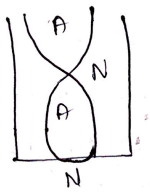
$$\ell = \frac{\lambda}{4}$$

$$\lambda = 4\ell$$

First overtone:

It consists of two nodes and two antinode

$$n_2 = \frac{V}{\frac{4\ell}{3}}$$



$$\ell = \frac{3\lambda}{4}$$

$$n_2 = \frac{3V}{4\ell}$$

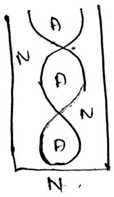
$$\lambda = \frac{4\ell}{3}$$

$$n_2 = 3n_1$$

Second overtone:

It consists of three antinode and three nodes

$$n_3 = \frac{V}{\frac{4\ell}{5}}$$



$$\ell = \frac{5\lambda}{4}$$

$$n_3 = 5n_1$$

$$\lambda = \frac{4\ell}{5}$$

$n_1 : n_2 : n_3 = 1 : 3 : 5.$

4. What is Doppler effect? Obtain an expression for the apparent frqeucny of sound heard when the source is in motion with respect to an observer at rest.

A. Doppler Effect : The apparent change in the frequency due to relative motion between the source nad observes is called Doppler effect.

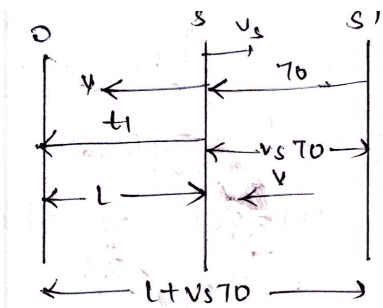
Expression : When the source 's' is moving away from stationary observer.

Let the source produce at crust and it reaches the observer in t_1' sec.

$$t_1 = \frac{L}{V} \text{ -------- (1)}$$

→ Now the source moved from 's' to 's'' in to sec with a velocity Vs and the second crest reaches the observer

$$t_2 = T_0 + \frac{L + VsT_0}{V}$$



Similarly

$$t_{n+1} = nT_0 + \frac{L + nVsT_0}{V} \text{ ----------(2)}$$

2 (-) 1

$$t_n = t_{n+1} - t_1 = n\,T_0 + \cancel{\frac{\ell}{V}} + \frac{n\,VsT_0}{V} - \cancel{\frac{\ell}{V}}$$

$$t_n = nT_0\left[1+\frac{Vs}{V}\right]$$

$$T^{l} = \text{time period} = \frac{t_n}{n} = \frac{\cancel{n}\,T_0\left[1+\frac{Vs}{V}\right]}{\cancel{n}}$$

$$\text{Apparent fue } n^{l} = \frac{1}{T'}$$

$$n^{l} = \frac{1}{T_0\left[1+\frac{Vs}{V}\right]} = n_0\left[1+\frac{Vs}{V}\right]^{-1} = n_0\left[1-\frac{Vs}{V}\right]$$

$$n^{l} = n_0\left[\frac{V-Vs}{V}\right] \qquad n^{l} < n_0$$

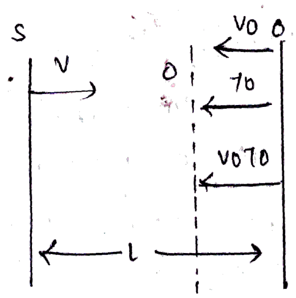
simlarly of 's' moves towards stationary observer.

$$n^{l} = n_0\,\frac{\mu_0 i_1 i_2 \ell}{2\pi r} \qquad n^{l} > n_0$$

5. What is Doppler Shift? Obtain an expression for the apparent frequency of sound heard when the observer is in motion with respect ot a source at rest.

A. __Doppler Shift:__ The change in the frequency of sound produced and apparent frequency of sound heard by teh listenes is called Dopller shift.

Expression : Observer is moving towards statonary source



$$t_1 = \frac{L}{V+V_0}$$

$$t_2 = T_0 + \frac{L-V_0T_0}{V+V_0}$$

$$t_{n+1} = n\,T_0 + \frac{L-nV_0T_0}{V+V_0}$$

$$T_n = t_{n+1} - t_1 = nT_0 + \cancel{\frac{L}{V+V_0}} - \frac{nV_0T_0}{V+V_0} - \cancel{\frac{L}{V+V_0}}$$

$$T_n = nT_0\left[1+\frac{V_0}{V+V_0}\right]$$

$$T = \frac{T_n}{n} = T_0\left[1-\frac{V_0}{V+V_0}\right]$$

$$n^{l} = \frac{1}{T} = \frac{1}{T_0\left[\frac{V_0}{V-V_0}\right]}$$

$$n' = n_0 \left[\frac{V+V_0}{V}\right]^{-1} \qquad n' > n_0$$

y (2) If '0' is moving away from the source $n' = n_0 \left[\frac{V-V_0}{V}\right]$ $n' < n_0$.

CURRENT ELECTRICITY

6. State Kirchhoff's Law for an electrical network using these laws deduce the condtion for balance in a wheat stone bridge.

A. **Kirchhoff's 1st Law:** The sum of the currents flowing towards a junction is equal to the sum of the current flowing away from the junction (or) the algebuia sum of current meeting at a junction is zero i.e., $\sum I = 0$.

Kirchhoff's 2nd Law: It is states that is any closed mesh of a circuit, the algebriun sum of the products of the current and resistance in each part of the loop is equal to the algebuia sum of the emf's in that loop $\sum IR = 0$.

Wheatston Bridge : Wheat stone buidge is used to compare the resistances to determine unknown resistance and to measure small strains in hard materials. This works on the principle of Kirchhoff's laws.

Description: Wheatstone Bridge consists of four resistors R_1, R_2, R_3 and R_4 connected in the four arms of a square to form four junctions A, B, C, D as shown in the figure. A galvanometer G is connected between the junction B and D. A battery of emf and no internal resistance is connected across the junction A and C . Let G be the resistance of the galvanometer.

Principle: The current in the resistances are shown and let 1g be the current passing through the galvanometer. Consider the case when the current throughthe galvanometer is zero i.e., I g=0. This is called bridge balancing condition.

By applying Kirchhoff's law to the junction B & D at junction 'B' $I_2 = I_4 + I_g \Rightarrow I_2 = I_4$ at junction. 'D' $I_1 + I_g = I_3 \Rightarrow I_1 = I_3$

By applying Kirchhoff's 2nd law to the closed loop ADBA

$$- I_1R_1 + 0 + I_2R_2 = 0$$

$$\Rightarrow I_1R_1 = I_2R_2 \Rightarrow \frac{I_1}{I_2} = \frac{R_2}{R_1} \text{ -----------(1)}$$

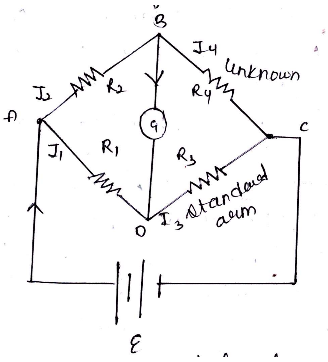
By applying Kirchhoff's 2nd law to the closed loop CBDC

$$I_2R_4 + 0 - I_1R_3 = 0$$

$$\Rightarrow I_2R_4 = I_1R_3 \ \frac{I_1}{I_2} = \frac{R_4}{R_3} \text{ -------------------- (2)}$$

From equation (1) and (2) $\frac{R_2}{R_1} = \frac{R_4}{R_3}$

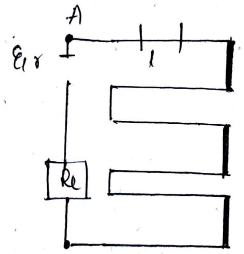
This is called bridge balancing condition.



7. State the working principle of potentiometer explain with the help of a circuit diagram how the emf of two primary cells are compared by using the potentiometer.

A. **Description:** A potentiometer consists of uniform wire of length 10m arranged between A and C as 10 wires each of length 1m on a wooden board.

The balancing length is measured from the end which is connected to the positive terminal of the battery by moving the Jockey J on the wire.



Principle :

L - Length of wire

R - Resistance of wire

Resistance of 'ℓ' is = $\left(R/L\right)\ell$

$$I = \frac{\varepsilon}{r+Rs+R}$$

Potential across 'ℓ'

V = I x resistance

$$V = \frac{\varepsilon}{r+Rs+R}\left[\frac{R}{L}\right]\ell$$

$$V = \phi\ell$$

$$\phi = \frac{V}{\ell} = \text{Potential}$$

$$V \propto \ell$$

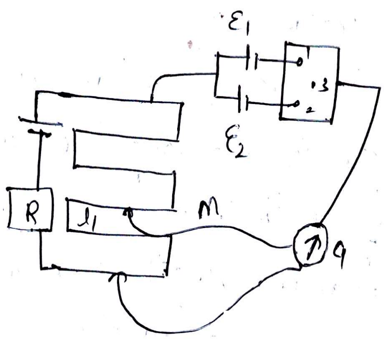
To compare e.m.f of cells :

$$\varepsilon = \phi\,\ell_1$$

$$\varepsilon_1 \propto \ell_1$$

$$\varepsilon_2 \propto \ell_2$$

$$\frac{\varepsilon_1}{\varepsilon_2} = \frac{\ell_1}{\ell_2}$$



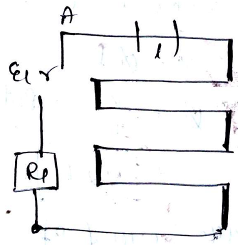
Precautions :

1. Jockey schould not be damagged.
2. Current value should be small.
3. Current should be passed only white taking the reading.

8. State the working principle of potential explain with the help of a circuit diagram how the potentiometer is used to determine the internal resistance of the given primary cell.

A. **Description :** A potential consists of uniform wire of length 10m arraged between A and C as 10 wires each of length 1m on a wooden board since the wire is uniform the p.d between A and any point at a distance ℓ from A is $\varepsilon(\ell) = \phi d$ where ϕ is the potential drop per unit length of the potentiometer wire.

Principle:



I = Length of the wire

R = Resistance of wire

Resistance of " is $\left(R/L\right)\ell$

$$I = \frac{\varepsilon}{r+Rs+R}$$

Potential across 'ℓ'

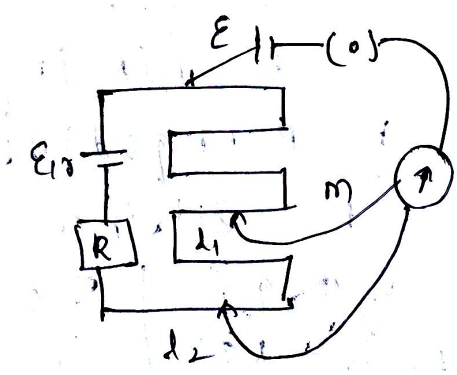
V = I x resistance

$$V = \frac{\varepsilon}{r + Rs + R}\left[\frac{R}{L}\right]\ell$$

$$V = \phi\ell$$

$$\phi = \frac{V}{\ell} = \text{Potential}$$

$$V \propto \ell$$



Inter resistance (r) :

$$\varepsilon_1 \propto \ell_1$$
$$V \propto \ell_2$$

$$\frac{\varepsilon}{V} = \frac{\ell_1}{\ell_2}$$

$$\frac{\ell_1}{\ell_2} - 1 = \frac{r}{R} \Rightarrow \frac{r}{R} = \frac{\ell_1 - \ell_2}{\ell_2}$$

$$r = R\left[\frac{\ell_1 - \ell_2}{\ell_2}\right]$$

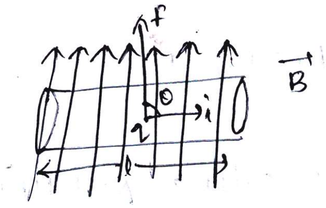
Precautions:

1) Jockey should not beduagged along the wire.
2) Current value should be small.
3) Current should be passed while taking readings.

MOVING CHANGES AND MAGNETISM

9. Deduce an expression for the force on a current carrying conductor placed in a magnetic field. Derive an expression for the force per unit length between two parallel current conductors.

A. Let us consider a conductor of length 'ℓ' area of cross section 'A' placed in unforum magnetic field of induction $\overline{B}$ as shown in the figure.



Force acting on the charge

$$F = -q\left(\overline{V} \times \overline{B}\right)$$

$$= -B_2 V \sin\theta$$

Area of conductor = A

Vel of change = Vd

Falling acting on the conductor

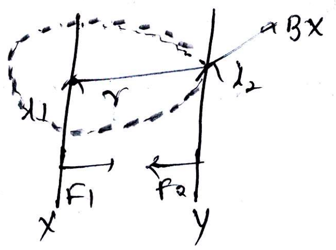
$$F = n\ell Af$$
$$F = n\ell A(Bqv\sin\theta)$$
$$F = B(nAqvd)\ell\sin\theta$$
$$F = Bil\sin\theta$$

If $\theta = 90^0$ If $\theta = 0^0$

f max = Bil   f min = 0

Let us consider two parallel conductors x and y seperated by a distance 'r' as shown in the figure

Let i_1 and i_2 be the currents passing through the conductors.



$$B_x = \frac{\mu_0 i_1}{2\pi r}$$

Force acting on 'y' due to Bx is

$$F_y = B \times i_2\ell \quad (\therefore \theta = 90^0)$$

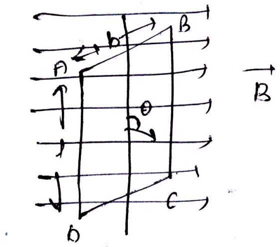
$$F_y = \frac{\mu_0 i_1 i_2 \ell}{2\pi r}$$

similarly By = $\frac{\mu_0 i_2}{2\pi r}$ and F x = $\frac{\mu_0 i_1 i_2 \ell}{2\pi r}$ $\therefore F_1 = F_2 = F_3 = \frac{\mu_0 i_1 i_2 \ell}{2\pi r}$

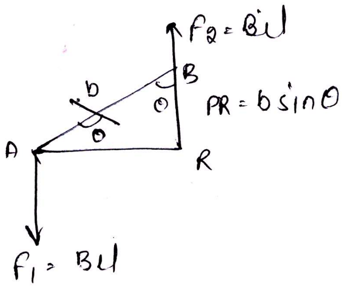
Force acting per unit length $\frac{F}{\ell} = \frac{\mu_0 i_1 i_2}{2\pi r}$

10. Obtain an expression for the torque on a current carrying loop placed in a uniform magnetic field. Describe the construction and working of a moving coil galvanometer.

A. Let us consider a rectangular coil of length 'ℓ' breadth 'b' placed in uniform magnetic field as shown in the figure.



Along the length side
(AD and BC)
$F_1 = F_2 = Bil$ [$\because \theta = 90^0$]
Along AB and CD $F_3 = F_4 = Bib$
Resultant force along
AB & CD = 0
Torque T = one of the force
X perpendicular distance (PR)
T = Bil b sinθ
T = Bi A sinθ



For 'N' no. of turns

If $\theta = 90^0$ — Tmax = Bi AN

If $\theta = 0^0$ — Tmin = 0

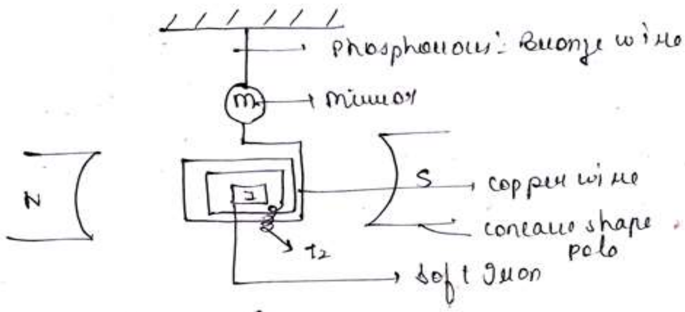
<u>Moving coil Galvanometer:</u>

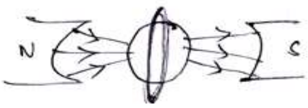
Let us consider a copper wire wound on a non-metallic frame and placed in between concave shaped poles as shown in the figures.

→ Let 'm' be the merror is used to measure the number of deflections.

→ It is used to detect and measure small electric current of the order 10^{-9} amper's.

<u>Principle:</u> When a current carrying coil placed in a uniform magnetic field it experences a torque.





In equilibrium position
Torque = Resoring couple
Bi AN = Cθ

$$i = \frac{c}{BAN}\theta$$

i = kθ

$i \propto \theta$

11. Explain the principle and working of a nuclear reactor with the help of a labelled diagram.

A. **<u>Principle of Nuclear Reactor:</u>** Nuclear reactor is used to produce a large amount of nuclear energy through a controlled nuclear fission process.

The essential part of a nuclear reactor are

i) Nuclear fuel ii) Moderator iii) Control rods iv) Protective shielding v) Coolant

i. **<u>Nuclear Fuel :</u>** The fissionable material used in the reactor is called nuclear fuel. The uranium isotopes $_{92}U^{235}$ and $_{92}U^{238}$. Platenium Pu and thorium $_{99}Th^{232}$ are commonly used fuels in the rectors.

ii. **<u>Moderators:</u>** Core contain moderators. These are used to slow down the fast moving neutrons produce in the fission process. The material used as moderators are heavy water carbon in the form of pure graphite hydrocarbon plastics etc. The core is surrounded by reflectors to reudce leakage.

iii. **<u>Control rods:</u>** These are the materials that can absorb the neutrons and control the nuclear chain reaction cadmium or Boron or Beryllium rods are generally used for htis purpose.

iv. **<u>Protective Shielding:</u>** It is used to prevet the spreading of radioactive effect to the space around the nuclear reactor. For this purpose lead block, concrete walls of thickness 10m is used.

v. **<u>Coalant :</u>** The material used to absorb heat generated in the reactor is called coolant. The coolants are water moltten sodiuom etc.

<u>Working:</u>

i. Uranium fuels are placed in the aluminium cylinders which are sepracted by some distance. The graphite moderators in the form of pure carbon blocks is placed in between the fuel cylinder.

ii. To control the number of neutrons a number of control rods of codium or beryllium or boron are placed in the holes of graphite block.

iii. When thermal neutron collides with U^{235} nuclei it undergoes fission then produces fast neutrons are liberated. These neutrons pass through the surronding graphite moderator and lose their kinetic energy to become thermal reaction.

iv. These thermal neutrons are captured by U^{235} which carries out the fission reaction.

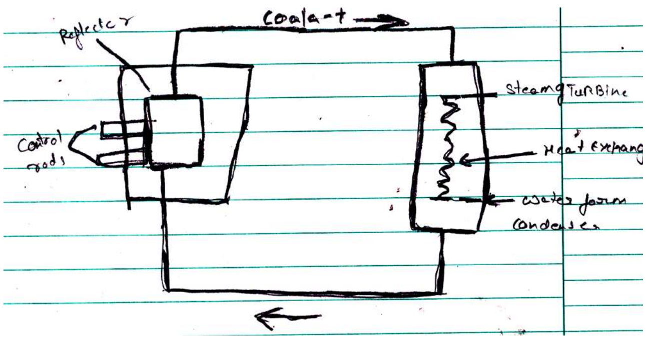
v. By using control rods the fission process can be controlled by obsorbing neutrons.

vi. The steam used to rotate a turbine for the production of electric power.

<u>Used of nuclear reactors:</u>

To generate electric power.

To produce radioactive materials like plutonium -239 used in the filed of medicine, industry etc.



**********The End*********

S AQ'S (4 MARKS)

RAY OPTICS

1. Define focal length of a concave mirror prove that the radius of curvature of concave mirror is double its focal length?

A. When a light ray incident parallel to the principal axis of a concave mirror gets reflected through a principle focus 'F' if 'C' is the centre of curvature and CP is the normal to the mirror at 'P'

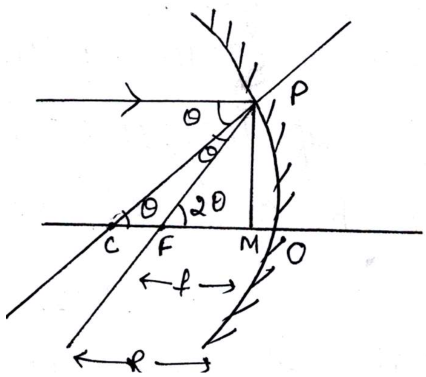
$\angle CPO = \theta$

$\angle OPF = 2\theta$

From ΔFPO

$$\text{Tan } 2\theta = \frac{PM}{FM}$$

From ΔCPO $\tan\theta = \dfrac{PM}{CM}$



If θ is small

$\tan\theta \approx \theta$ and $\tan 2\theta \approx 2\theta$

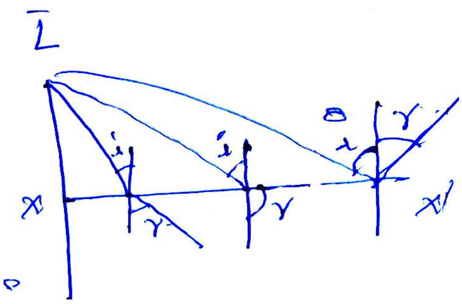
$$2Q = \frac{PM}{FM} \Rightarrow 2\left(\frac{\cancel{PM}}{CM}\right) = \frac{\cancel{PM}}{FM} \Rightarrow \frac{2}{R} = \frac{1}{F} \Rightarrow F = \frac{R}{2}$$

2. Define critical angle. explain total internal refelction using a neat diagram?

A. **Critical angle** :- When a light ray is refracted from denser medium to rarer medium at particular angle of incidence. If the angle of refraction is 90^0. Then the angle of incidence is called critical angle.

$$n_{12} = \frac{1}{\sin i_c}$$

Total Internal refelction :- When the light is propagated from denser medium to rarer medium. If the angle of incidence is greater than critical angle. Then the right ray is completely reflected in the same medium is called total internal reflection.



Explanation :- Consider a light ray passing from denser mediun to a rarer medium. The light ray after refraction bends away from the normal. If the angle of incidence increases then angle of refraction increases as sin r α sin i. If the angle of incidence equal to critical angle at 'A' " then the refracted ray just grazes the surface xx' and angle of fraction becomes 90^0. If the angle of incidence (i) increases further greater than critical angle then it reflects into the same denser medium. This is known as total internal reflection.

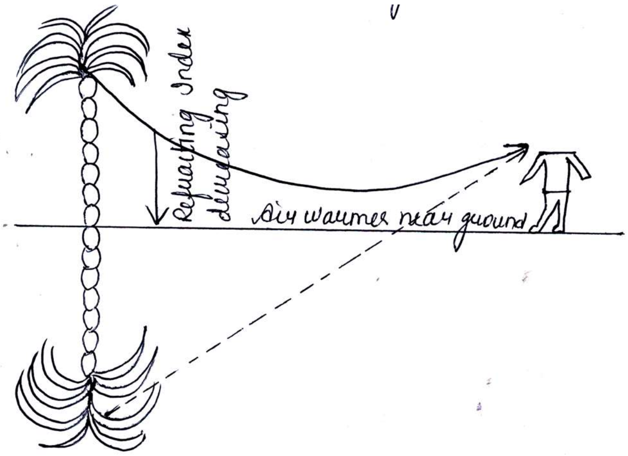
Condition for total internal reflection :

1. The Light ray must travel from denser to rarer medium.
2. The angle of incidence in the denser medium must be greater than the critical angle.

3. Explain the formation of mirage ?

A. **<u>Mirage</u>** :- It is an optical illusion observed in deserts and coal tarred roads on a hot day. The object such as a true appears inverted and the observer gets the impression as if the inverted image has been formed by a pool of water. This phenomenon is known as mirage.

Explanation :- In summer, the layers of air near the gorund are hotter that the air at higher levels Hotter air is less density, and has smaller refractive index than the cold air. In still air, The optical density at different layers of air increases with hight As a result, light from a tall object such as tree, passes the medium whose refractive index decreases towards the ground. Then a ray of light from the object successively bends away from the normal. If the angle of Incidence for the air near the ground exceeds the critical angle. total internal reflection takes place. tp a distant observer, the light appears to be coming from somewhere below the ground such inverted images of distant tall objects causes an optical illusion to the observer. This phenomenon is called mirage.



4. Explain the formation of a rainbow?

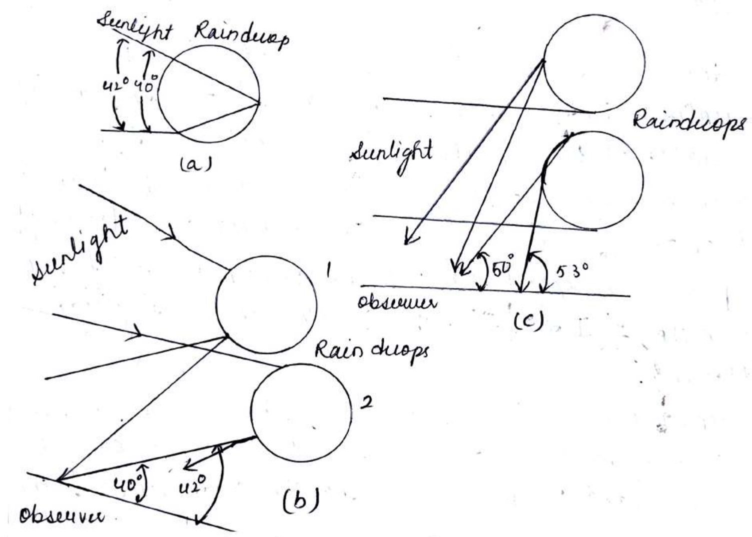
A. **<u>Formation of Rainbow</u>** :-

1) The rainbow is an example of the dispersion of sunlight by the water drops in the atmosphere. This sunlight by the water drops in the atmosphere. This is due to combined effect of dispersion, refraction and reflection of sunlight by spherical rain droplets.

2) An observer can see a rainbow only when his back is towards the sun In order to understand the formation of rainbow, consider figure (a) sunlight is first refracted as it entires a raindrops. This causes the different wavelengths of white light to separate longer wavelength of light are bent the least while the shorter wavelength are bent the most. These component rays strike the inner suface of the water drop and get internally reflected. if the angle between the refracted ray and normal to the drop surface is greater than the critical angle the reflected light is refracted again as it comes out of the drop as shown in the figure. It is found that the violet light emerges at an angle of 40^0 related to the incoming sunlight and red light emerges at an angle of 42^0 - for other colours angles lie in between these two values.

3) Figure (b) explains the formation of primary rainbow Red light from drop 1, and violet light from drop 2 reach the observers eye. The violet from drop 1 and red light from drop 2 are directed level above or below the observer. Thus the observer sees a rainbow with red colour on the top and violet on the bottom thus, the primary rainbow is a result of reflection and refraction.

4) When light rays undergoes two internal reflections inside a raindrop, instead of one as in the primary rainbow, secondary rianbow as shown in figure (c). The intensity of light i is reduced at the second reflection and hence the secondary rainbow is fainter than the primary rainbow. Also the order of the colours is reversed.

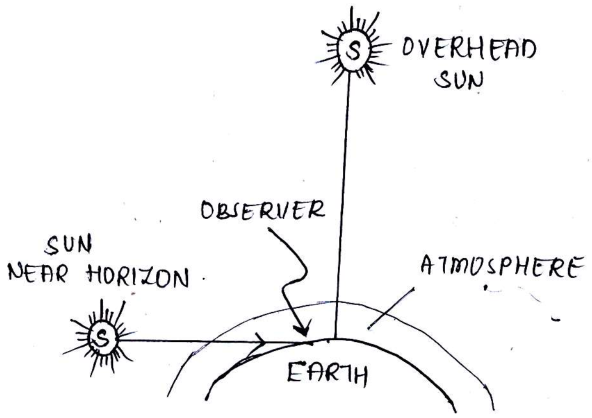


5. Why does the setting sun appear red?

A. As sunlight travels through the earths atmosphere, it gets scattered by the atmospheric particles. light of shorter wavelengths is scattered much more than light of longer wave lengths the amount of scattering is inversely proportional to the fourth power of the wavelength $\left(I\alpha\frac{1}{\lambda^4}\right)^T$. This is known as Rayleigh scattering.

At sunrise or sunset the sun looks almost reddish the reason is that at the time of sun set or sun rise, The light from the sun has to transverse larger thickness of atmosphere than what it covers when the sun is overhead as shown in figure.

Due to this, more of the blue and shorter wave length of sun light is removed by scattering and the least scattered light i.e., red reaches our eye. so the sun looks reddish.



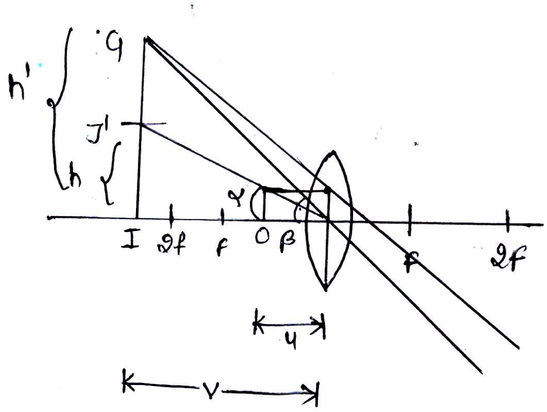
6. With a neat labelled diagram explain the formation of image in a simple microscope?

A. **Simple microscope** :- A convex lens of short focal length is used as a simple microscope The lens is arranged in a circular metallic frame.

Formation of image :- An object OJ is placed within the principle focus F of the convex lens. The image is virtual and magnified.

$$\text{Magnifying power} = M = \frac{\text{vitual angle with instrument}}{\text{Maximum vitual angle extended by } \angle i}$$

$$\therefore M = \frac{D}{u}$$



we know that $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

f is +ve But v & u are -ve

$$\frac{1}{f} = -\frac{1}{v} - \left(-\frac{1}{u}\right)$$

$$\frac{1}{u} = \frac{1}{f} + \frac{1}{v}$$

But $M = \frac{D}{u} = D\left(\frac{1}{f} + \frac{1}{v}\right)$

Image is at near point v=D

$$M = D\left(\frac{1}{f} + \frac{1}{D}\right) = \frac{D}{f} + 1$$

At far point v = α

$$M = D\left(\frac{1}{f} + \frac{1}{\alpha}\right) \qquad \Rightarrow M = \frac{D}{f}$$

7. A light ray passes through a prism of angle A in a position of minimum deviation Obtain an expression for (a) The angle of incident in terms of the angle of the prism and the angle of the manimum deviation (b) The angle of refraction in terms of the refraction index of the prism ?

A. Let us consider a prism ABC of angle of incidence i_1 and angle of emergent i_2 as shown in the figure. from fig

Angle of prism :- From Quadrilateral

Δ PQNA

$r_1 + r_2 + \angle N = \angle N + A$

$r_1 + r_2 = A$

If $r_1 = r_2 = r \Rightarrow r = \frac{A}{2}$

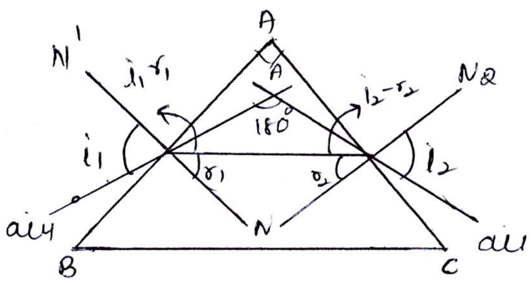
from Δ PQ.A

$i_1 - r_1 + i_2 - r_2 + \cancel{180} - \delta = \cancel{180}$

$i_1 + i_2 = \delta + (r_1 + r_2)$

$i_1 + i_2 = \delta + A$

if i1 = i_2 = i



$i = \frac{\delta + A}{2}$

But from snell's law $\mu = \frac{\sin i}{\sin r}$

$$\mu = \frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin\left(A/2\right)}$$

* For small angle prism :-

$$\sin\left(\frac{A+\delta}{2}\right) \approx \left(\frac{A+\delta}{2}\right)$$

sin A/2 = A/2

$$\mu = \frac{\frac{A+\delta}{\cancel{2}}}{A/\cancel{2}} \qquad \Rightarrow \mu = \frac{A+\delta}{A}$$

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WAVE OPTICS

8. Explain Doppler effect in light Distinguish between red shift and bllue shift.

A. **Doppler Effect in light** :-

1. The apparent change in frequency (or) wave length of light is called doppler effect in light.
2. If 'ϑ' is the actual frequency and '$\Delta\vartheta$ is the apparent frequency, then the relative change in frequency.
3. $\frac{\Delta\vartheta}{\vartheta} = \frac{-V}{C}$ or $\frac{\Delta\lambda}{\lambda} = \frac{V}{C}$
4. Here 'C' is the speed of light and 'V' is the velocity of the source which is small compared to that of light Doppler effect in light is symmetric

5. **Red shift**	**Blue shift**
1. The spectrum of Radiation from the source of light shif towards red end of the spectrum. this is called red shift	1. The spectrum of radiation from the source of light shifts towards the blue end of the Spectrum. this is called blue shift
2. When the source is moving away from observer the wave length emitted increases	2. When the source is moving towards the observer the wavelength emitted decreases
3. $\Delta\lambda = +\frac{\vartheta}{C}\lambda$	3. $\Delta\lambda = -\frac{\vartheta}{C}\lambda$
4. This confirms the expanding nature of the universe	4. This confirms the universe is not expanding

9. Does the principle of conversation of energy hold for interference and diffraction phenomenon? explain briefly.

A. Yes, the principle of conservation of energy hold good for both the inference and diffraction phenomenon.

Explanation :

1. In the case of interference the energy will be disappear at the position of bright bands thus energy remains constant so principle of conservation of energy holds good for interference.

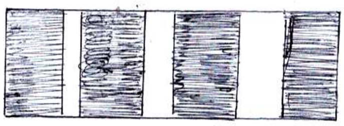
2. In diffraction phenomenon, the interference of secondary wavelets takes place. therefore principle of conservation of energy holds good for diffraction.

3. In both the interference and diffraction, redistribution of energy takes place. The energy is average energy of waves remains same. There is no loss or gain of energy due to formation of dark and bright bands in interference and diffraction of light. Thus they do not violate law of conservation of energy.

10. How do you determine the resolving power of your eye?

A. **Resolving power** :- The ability of an optical instrument to produce distinctly separate image of two objects located very close to each other is called resolving power.

Resolving power of eye :- make black stripes of equal width sparated by white strepes all the white stripes should be of equal width, while that of white stripes should increase from left to right for example let the black stripes have a width of 5mm. let the width of two which stripes be 0.5 mm each, the next two white stripes be 1mm each, the next 1.5 mm each, etc. paste this pattern on a wall in the room at the height of your eye.



Now watch the pattern with one eye. by moving away or closer to the wall, find the position where you can just see some black stripes as separate stripes. All the black stripes to the right of this would be more clearly visible. If 'd' is the width of the white stripe and 'D' is the distance of the wall from two crossed eye.Then d/D is the resolution of the eye.

11. Derive the expression for the intensity at a point where interference of light occurs. Arive at the condition for maximum and zero intensity.

A. **Interference**:- The redistribution of energy due to super imposition of two or more waves is called interference

Theory :- Let y_1 and Y_2 are the displacements produced by the coherent waves at any 'P' on the screen. The waves can be represented by

$y1 = a \cos \omega t$ and $y_2 = a \cos (\omega t + \theta)$

Here a = amplitude , and w = Angular frequency and the resultant displacement 'y' is given by

$y = y_1 + y_2 \Rightarrow y = a \cos wt + a \cos (wt + \theta)$ or

$y = 2 a \cos (\theta/2) \cos (wt + \theta/2)$

The amplitude of the resultant displacement is $2a \cos (\theta/2)$ and hence the intensity at that point will be $I = 4 I_0 \cos^2. \theta/2$

Condition for maximum intensity :-

$\theta = 0, \pm 2\pi, \pm 4\pi$ ....leads maximum intensity or constructive interference.

Condition for zero intensity :- $\theta = \pm \pi, \pm 3\pi, \pm 5\pi$ ....leads minimum or zero intensity or destructive interference.

12. Discuss the intensity of transmitted light when a polaroid sheet is rotated between crossed, polaroids.

A. Let I_0 be the intensity of polarised light after passing through the first polariser P_1, then the intensity of light after passing through second polariser p_2 will be

$$I = I_0 \cos^2 \theta$$

Where q is the angle between pass axes of p_1 and p_2 since p_1 and p_3 are crossed the angle between the axes of p_2 and p_3 will be $(\pi/2 - \theta)$. hence the intensity of light emerging from p_3 will be

$$I = I_0 \cos^2 \theta \cos^2\left(\frac{\pi}{2} - \theta\right)$$

$$= I_0 \cos^2 \theta \sin^2 \theta = (I_0/4) \sin^2 2\theta$$

therefore, the transmitted intensity will be maximum when $\theta = \pi/4$

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ELECTRIC CHARGES AND FIELDS

13. State and explain coulomb's inverse law in electricity.

A. The force of attraction or repulsion between the charges is directly proportional to the product of their changes and inversely proportional to the square of the distance between them.

$F \propto q_1 q_2$

$$F \propto \frac{1}{r^2}$$

$$F \propto \frac{q_1 q_2}{r^2}$$

$$F_a = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$$

$$\therefore \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$$

$\therefore E_0$ - permitivity of free space.

$\varepsilon_0 = 8.85 \times 10^{-12}$ Fery/meter

It opposes the flow of charge

$$F_m = \frac{1}{4\pi\varepsilon} \frac{q_1 q_2}{r^2}$$

ε - permitivity of medium

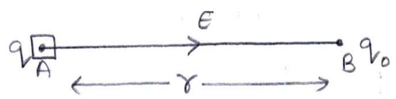
$$\frac{F_a}{F_m} = \frac{\frac{1}{\varepsilon_0}}{\frac{1}{\varepsilon}} = \frac{\varepsilon}{\varepsilon_0} = \varepsilon_r \Rightarrow k \quad \text{(Relative permitivity)}$$

14. Define intensity of electric field at a point derive an expression for the intensity due to a point charge.

A. Let us consider a charge q be placed at a point A.
We can find out the intensity of electric field at a point B as shown in figure.

* From coulomb's law $F = \frac{1}{4\pi\varepsilon_0}\frac{qq_0}{r^2}$

But $E = F/q_0 = \dfrac{\frac{1}{4\pi\varepsilon_0}\frac{qq_0}{r^2}}{q_0}$

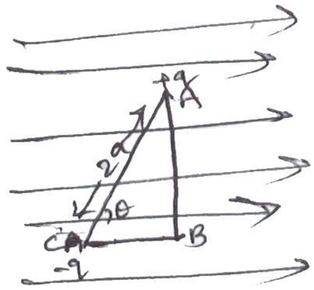


$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^3}\vec{r}$

15. Derive the equation for the couple acting on a electric dipole in a uniform electric field.

A. Let us consider on electric dipole placed in uniform electric field. There are two equal and opposite forces acting on a dipole constitutes couple on it.
Couple acting on the dipole
C = one of the force x perpendicular distance
= Eq (AB)



From ΔABC $\sin\theta = \frac{AB}{2a}$

$AB = 2a \sin\theta$

$C = Eq\,(2a \sin\theta)$

$C = Ep \sin\theta$ $[\because p = 2aq]$

$\vec{C} = \vec{P} \times \vec{E}$

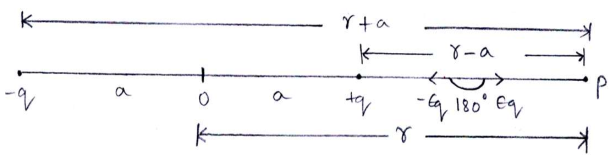
$C_{max} = PE$, $\theta = 90^0$, $\sin 90^0 = 1$

$C_{min} = 0$. $\theta = 0^0$, $\sin 0^0 = 0$

16. Derive an expression for the electric intensity of the electric field at a point on the axial line of an electric dipole.

A. __Axial line__ :- The line which is passig through the charges of dipole is called axial line the resultant intensity at p is

$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$



$Eq = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2}$

$-Eq = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r+a)^2}$

*Resultant intensity :- $E = {}_{+}Eq - {}_{-}Eq$

$E_A = \frac{1}{4\pi\varepsilon_0}\, q\left[\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right]$

$$E_A = \frac{1}{4\pi\varepsilon_0} \quad q\left[\frac{(r+a)^2-(r-a)^2}{(r-a)^2(r+a)^2}\right]$$

$$E_A = \frac{1}{4\pi\varepsilon_0} \quad q\left[\frac{\cancel{r^2}+\cancel{a^2}+2ar-\cancel{r^2}-\cancel{a^2}+2ar}{(r^2-a^2)^2}\right]$$

$$E_A = \frac{1}{4\pi\varepsilon_0} \quad q\left[\frac{4ar}{(r^2-a^2)^2}\right]$$

$$E_A = \frac{1}{4\pi\varepsilon_0} \frac{(2aq)2r}{(r^2-a^2)^2} \qquad [\because \text{but} = 2aq]$$

$$E_A = \frac{1}{4\pi\varepsilon_0} \frac{(2p)\cancel{r}}{r^{\cancel{4}}} \qquad [\because \text{if } r>>a \text{ we can neglect } a^2]$$

$$E_A = \frac{1}{4\pi\varepsilon_0} \frac{(2p)}{r^3}$$

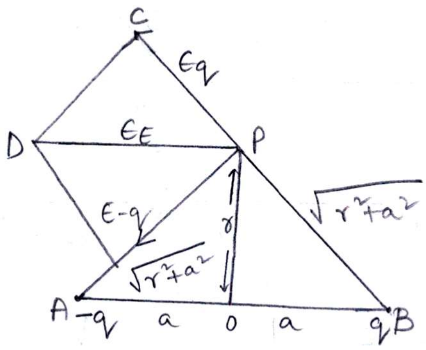
17. Derive an expression for the electric intensity of the electric field at a point on the equatorial plane of an electric dipole.

A. Equatorial line :- The line which is passing through the perpendicular bisector of the electric dipole is called equatorial line.

* From figure :-

$$E_{-q} = E_q = \frac{1}{4\pi\varepsilon_0} \frac{q}{\left(\sqrt{r^2+a^2}\right)^{\cancel{2}}}$$

ΔABP and ΔPCD are similar triangles



$$\frac{E_E}{2a} = \frac{Eq}{\sqrt{r^2+a^2}}$$

$$\frac{E_E}{2a} = \frac{\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2+a^2}}{\sqrt{r^2+a^2}}$$

$$\frac{1}{4\pi\varepsilon_0} \frac{2aq}{\left(r^2+a^2\right)^1 (r^2+a^2)^{1/2}}$$

$$E_E = \frac{1}{4\pi\varepsilon_0} \frac{p}{\left(r^2+a^2\right)^{3/2}}$$

If r >>a, we can neglect a2

$$E_E = \frac{1}{4\pi\varepsilon_0} \frac{p}{r^3}$$

18. State Gauss's law in electrostatics and explain its importance?

A. **GAUSS'S LAW** :- " The electric flux (ϕ) through any closed surface is equal to $\frac{1}{\varepsilon_0}$ times the net charge enclosed by the surface ".

$$\phi = \oint \vec{E}.\vec{ds} = \frac{1}{\varepsilon_0} q$$

$\rightarrow$ This is the integral from of gauss's law

$\rightarrow$ q = charge, E = electric field

$\rightarrow$ ε_0 is the permitivity of free space.

* Importance :- Symmetrically consideration in many problems make application of good for any closed surface of any shape.

2. Gauss theorem holds good for any closed surface of any shape.
3. Gauss theorem gives relation between electric field at the charge
4. Gauss theorem is valid for stationery charges as well as for rapidly moving charge.

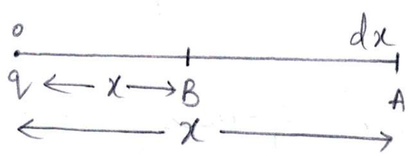
ELECTROSTATIC POTENTIAL AND CAPACITANCE

19. Derive an expression for the electric potential due to a point charge.

A. Let us consider a point charge 'q' fixed at a point 'o' in freeze phase. Let us find electric potential at point 'b' due to charge 'q' -

dw = -F.dx

Where [F= $\frac{1}{4\pi\varepsilon_0}\frac{qq_0}{x^2}$]



$$dw = \int_{\infty}^{r} -\frac{1}{4\pi\varepsilon_0}\frac{qq_0}{x^2}dx$$

$$w = -\frac{1}{4\pi\varepsilon_0}qq_0\int_{\infty}^{r}\frac{1}{x^2}dx$$

$$w = -\frac{1}{4\pi\varepsilon_0}qq_0\left[-\frac{1}{x}\right]_{\infty}^{r}$$

$$w = -\frac{1}{4\pi\varepsilon_0}qq_0\left[\frac{1}{r}-\frac{1}{\infty}\right]$$

$$w = -\frac{1}{4\pi\varepsilon_0}\frac{qq_0}{r}$$

[$\because$ but V = $\frac{w}{q_0}$]

$$V = -\frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$

20. Derive an expression for the potential energy of an electric dipole placed in a uniform electric.

A. **Electric dipole** :- Two equal and opposite charges separated by a small distance is called an "electric dipolle".

Let 'q' be the charge, 2a be the length and it makes an angle θ with electric field as shown in figure.

$\rightarrow T = PE \sin\theta$

$\rightarrow dw = Tdq$

[where $w = \int dw$]

* $W = \int PE \sin\theta\, d\theta$

$W = PE \int \sin\theta\, d\theta$

[where $\int \sin\theta\, d\theta = -\cos\theta$]

$W = PE(-\cos\theta)$

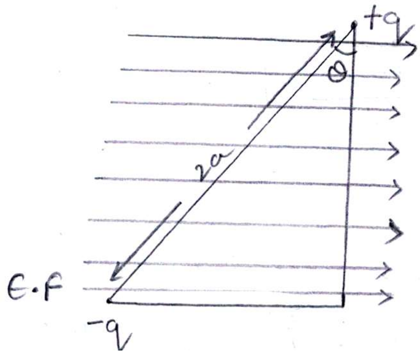
$W = -PE \cos\theta$

$\rightarrow$ If $\theta = 0^0$, $\cos\theta = 1$

$W = -PE$

$\rightarrow$ If $\theta = 180$, $\cos 180 = -1$

$W = PE$



21. Derive an expression for the capacitance of a parallel plate capacitor.

A. Let us consider a parallel plate capacitor which consists of to plates each with area (A) and separated by a distance (d) as shown in figure.

$\rightarrow$ Intensity of electric field between thee plates

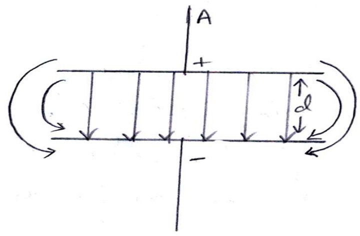
$$E = \frac{\sigma}{\varepsilon_0}$$

$$\because \text{ where } \left[E = \frac{v}{d}, \sigma = \frac{q}{A}\right]$$

$$\frac{v}{d} = \frac{q}{A\varepsilon_0}$$

$$\frac{q}{v} = \frac{A\varepsilon_0}{d} \quad [\because \text{ where } \frac{q}{v} = c]$$

$$C = \frac{A\varepsilon_0}{d}$$

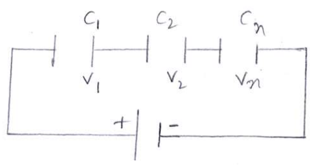


22. Explain series and parallel combination of capacitors. Derive the formula for equivalent capacitance in each combination.

A. <u>**Series combination**</u> :- In series combination the capcitors are first arranged in series order such that the 2nd plate of 1st capcitor is connected to 1st plate of third capacitor and so on. Finally the 1st plate of 1st capacitor and 2nd plate of last capacitor are connected to the battery.

$\rightarrow$ Where 'q' is constant and 'v' is variable.

$$v = \frac{q}{c},\ v_1 = \frac{q}{c_1},\ v_2 = \frac{q}{c_2},\ v_3 = \frac{q}{c_3} \ldots\ldots\ldots\ldots, v_n = \frac{q}{c_n}$$



$$\frac{\cancel{q}}{c} = \cancel{q}\left[\frac{1}{c_1}+\frac{1}{c_2}+\frac{1}{c_3}.....+\frac{1}{c_n}\right]$$

$$\frac{1}{C} = \left[\frac{1}{c_1}+\frac{1}{c_2}+\frac{1}{c_3}.....+\frac{1}{c_n}\right]$$

* Parallel combination 1^{st} plate of all the capacitors are giving to one terminal of the battery and all 2^{nd} plates are giving to opposite terminals of the battery. This combination is called parallel combination.

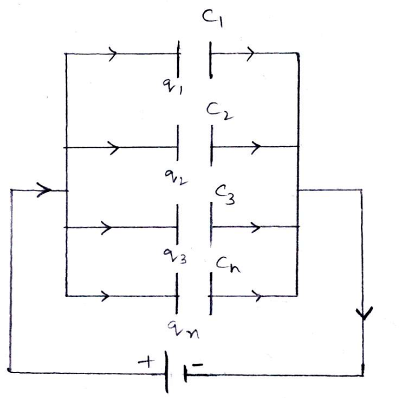
'v' is constant but 'q' is variable

$q = cv,\ q_1 = C_1v,\ q_2 = C_2 V,\ q_3 = C_3 V........q_n = C_nV$

$q = q_1+q_2+q_3.......+q_n$

$C\cancel{V} = \cancel{V}\ [C_1+C_2+C_3+.....Cn]$

$C = C_1+C_2+C_3.......C_n$



23. Derive an expression for the energy stored in a capacitor. what is the enrgy stored when the space between the plates is filled with a dieletric.
a) With charging battery disconnected?
b) With charging battery connected in the circuit ?

A. Energy stored in a capacitor :- Let us consider a capacitor of capacity (c) is charged to a potential (v) by giving a charge (q) on it.

$dw = vdq$

$\because$ but $v = \frac{q}{c}$

$$dw = \frac{q}{c}dq$$

$\rightarrow$ The work require to increase the charge from O to Q

$$w = \int_0^Q \frac{q}{c}dq$$

$$w = \frac{1}{c}\int_0^Q \frac{q}{c}dq$$

$$u = \frac{1}{c}\left[\frac{q^2}{2}\right]_0^Q$$

$$u = \frac{q^2}{2c} \quad \text{(or)}\ u = \frac{c\cancel{{}^2}v^2}{2\cancel{c}} = \frac{1}{2}cv^2$$

formula $\left[\int x^n dx = \frac{x^{n+1}}{n+1}\right]$

$$u = \frac{Q^{\cancel{2}}}{2\frac{\cancel{Q}}{V}} = \frac{1}{2}QV$$

$$C = \frac{Q}{V} \quad \Rightarrow Q = CV \quad \Rightarrow V = \frac{Q}{C}$$

(a)* With chaging battery disconnected :-

$$V^1 = \frac{V}{K}, \quad C^1 = \frac{Q}{\frac{V}{K}} = KC$$

$$V1 = \frac{1}{2}C^1V^{1^2} = \frac{1}{2}KC\left(\frac{V^2}{K^2}\right) = \frac{1}{2}\frac{CV^2}{K}$$

$$U^1 = \frac{u}{k}$$

(b)* With charging battery connected in the circuit :-

$q^1 = kq$, $v^1 = v$

$$c^1 = \frac{Kq}{v} = KC, \quad u == \frac{1}{2}CV^2$$

$$u^1 = \frac{1}{2}CV^2, \; R = \frac{1}{2}KCV^2$$

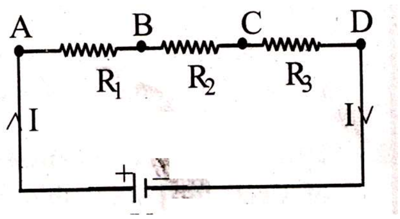
$u^1 = KV$

24. Derive an expression for the effective resistance when three resistors are connected in (i) Series (ii) Parallel.

A.i. Series Combination: Consider three resistors R_1, R_2 and R_3 are conneccted in series to a call of emf V. Since the three resitances are in series, same current flows through all the resistances. Let V_1, V_2 and V_3 be the potential difference across the three resistors respectively.

$V_1 = IR_1$ $V_2 = IR_2$ and $V_3 = IR_3$. But $V = V_1 + V_2 + V_3$

$\Rightarrow V = IR_1 + IR_2 + IR_3$



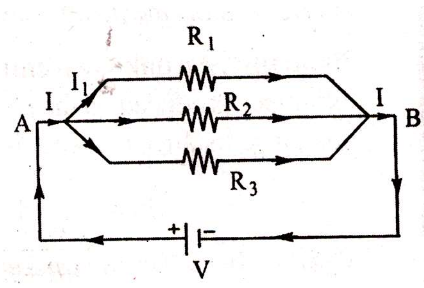
If equivalent resistance of the series combination is R, then

$V = IR = I(R_1 + R_2 + R_3)$ or $R = R_1 + R_2 + R_3$

Thus, equivalent resistance of a series combination of ersistors is equal to sum of resistances of all resistors.

ii. Parallel Combination: Consider three resistors R_1, R_2 and R_3 connected in parallel to a potential source (cell) V. Since the three resistors are parallel, the potential difference across cell resistor is same series V. Let i_1, i_2 and i_3 be the current through the resistors respectively.

$$I_1 = \frac{V}{R_1}, \; I_2 = \frac{V}{R_2} \text{ and } I_3 = \frac{V}{R_3}$$



$$\text{But } I = I_1 + I_2 + I_3 \text{ or } I = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\therefore \frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \text{ or } \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Thus the reciprocal of effective resistance is equal to the sum of reciprocals of individual resistances.

****

MOVING CHARGES AND MAGNETISM

25. State and explain Biot-Savart Law.

A. **Biot-Savart Law :** Biot - Savart Law gives the magnetic field induction at any point around the current carrying conductor of any shape.

Explaination : Consider a conductor 'QR' through which a current 'i' is passing the magnetic induction (dB) at any point due to small element is :

i. Directly proportional to the current i passing through the conductor.

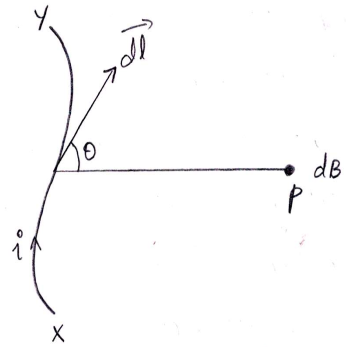
ii. Length of the small element ($d\ell$).

iii. Sine of the angle between the element and the line joining small element and the point ($\sin\theta$) and

iv. inversely proportional to the square of the distance (r^2) between the small element and the point.

→ The magnetic induction at 'p' is dB.

$$dB \propto i$$
$$dB \propto d\ell$$
$$dB \propto \sin\theta$$
$$dB \propto \frac{1}{r^2}$$



$$dB \propto \frac{i(d\ell)\sin\theta}{r^2}$$

$$dB = \frac{\mu_0}{4\pi}\frac{i\,d\ell\sin\theta}{r^2}$$

For induction $B = \int dB$

$$B = \frac{\mu_0}{4\pi}\int\frac{i\,d\ell\sin\theta}{r^2}$$

26. State and explain Ampere's Law.

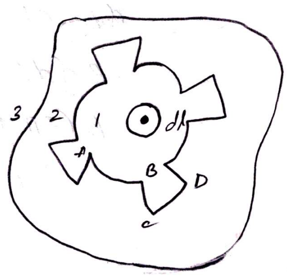
A. **Statement :** The line integral of $\vec{B}.\vec{d\ell}$ taken over the entire closed path of induction in a given perpendicular plane is equal to μ_0 times, the total current enclosed in the closed path . $\oint\vec{B}.\vec{d\ell} = \mu_0\, i$.

Explanation : Consider a long straight current carrying conductor emerging out perpendicular to the plane of the paper. The magnetic lines are in the form of concentric circles centred on the wire.

Consider some closed paths around the conductor as shown path 1 is circular and path 2 and 3 are of general shape. $d\ell$ is an elementry path 1 of radius 'r'. Let I be the current.

$$\bar{B}.\overline{d\ell} = \frac{\mu_0 I}{2\pi}\, d\theta$$

for path 1,



$$\therefore \oint\bar{B}.\overline{d\ell} = \oint\frac{\mu_0 I}{2\pi}d\theta = \frac{\mu_0 I}{2\pi}\oint d\theta = \mu_0 I.$$

$$(\because \oint d\theta \text{ for path 1 is } 2\pi)$$

$$\therefore \oint\bar{B}.\overline{d\ell} = \mu_0 I.$$

Similarly for the path 2,

$$\bar{B}.\overline{d\ell} = \frac{\mu_0 I}{2\pi}\theta_{AB}$$

$$\bar{B}.\overline{d\ell} = \frac{\mu_0 I}{2\pi}\theta_{CD} \text{ and so on.}$$

$$\therefore \oint \bar{B}.\overline{d\ell} = \frac{\mu_0 I}{2\pi}(\theta_{AB} + \theta_{CD} + \ldots\ldots\ldots\ldots) = \frac{\mu_0 I}{2\pi}(2\pi) \quad \therefore \oint \bar{B}.\overline{d\ell} = \mu_0 I.$$

This is known as Amper's Circuital Law.

27. Find the magnetic induction due to a long current carrying conductor.

A. Consider a circular path of radius 'r' drawn concentrically around a long thin conductor carrying current 'I' as shown in fig.

By the symmetry, magnetic induction B is same in magnitude at every point on the circular path and It is directed along tangent.

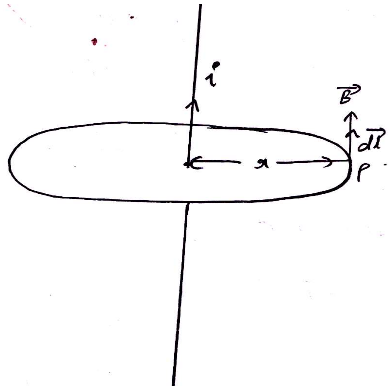
From amper's law,

$$\oint \bar{B}.\overline{d\ell} = \mu_0 I \ (\theta = 90^0)$$

$$\bar{B}\oint \overline{d\ell} = \mu_0 I$$

$$B(2\pi r) = \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi r}.$$



28. Derive an expression for the magnetic induction at the centre of a current carrying circular coil using Biot-Savart Law.

A. Consider a circular loop with centre 'θ and radius 'r'. Let 'i' be the current through the loop. The magnetic field induction at the centre of the loop due to the small element $d\ell$ is given by

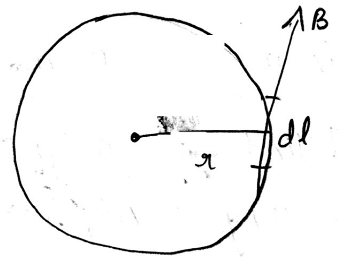
$$dB = \frac{\mu_0}{4\pi}\frac{i\,d\ell}{r^2}$$

$$B = \int dB = \frac{\mu_0}{4\pi}\frac{i}{r^2}\int d\ell$$

$$\text{But } \int d\ell = 2\pi r$$

$$B = \frac{\mu_0 i}{\cancel{4}\cancel{\pi}\cancel{r}^2}(\cancel{2}\cancel{\pi}\cancel{r})$$

$$B = \frac{\mu_0 i}{2r}$$



For 'n' turns $B = \frac{\mu_0 ni}{2r}$.

29. Derive an expression for the magnetic dipole moment of a revolving electron.

A. **Expression for the magnetic dipole moment of a revolving electron:** Consider a electron revolving in a circular orbit of raidus 'r' with a speed 'v' and frequency 'n'. Consider a point P on the circle. The electron cross the point once in every revolution. In one revolution, the electron travels a distance $2\pi r$. The number of revolutions made electron in one second is, $n = \left[\frac{v}{2\pi r}\right]$.

Current $i = \frac{q}{t} = q(n)$

$$i = e\left(\frac{v}{2\pi r}\right)$$

But dipole moment M = iA

$$M = \frac{ev}{2\cancel{\pi}\cancel{r}}[\cancel{\pi}\cancel{r}^{\cancel{2}}]$$

$$M = \frac{evr}{2}.$$

30. What are the basic components of a cyclotron? Mention its uses?

A. **<u>Cyclotron</u> :** Cyclotron is a device used to accelrate positively charged particles [like α-particles, deutrons etc.] cyclotron consists of the following basic components.

i. **<u>DEES</u>** : Two flat semicircular metallic boxes D_1 and D_2 are called Dees.

ii. **<u>Vacuum Chamber</u>** : The dees D_1 and D_2 are enclosed in a vacuum chamber to minimise collisions between the ions and air molecules.

iii. **<u>Source</u>** : The source is placed at the centre of dees which supplies the +ve ions (or) charges.

iv. **<u>Reasonant frequency Osicllator</u>**: It provides a powerful alternating electric field in the gap between the dees.

v. **<u>Powerful magnetic poles</u>**: Dees enclosed vacuum chamber is placed between two powerful magnetic poles.agnetic field revolves the ions in circular path.

vi. **<u>Deflector plate</u>** : The fast moving ions are deflected by deflector plate and strikes the target.

Uses:

Cyclotron is used

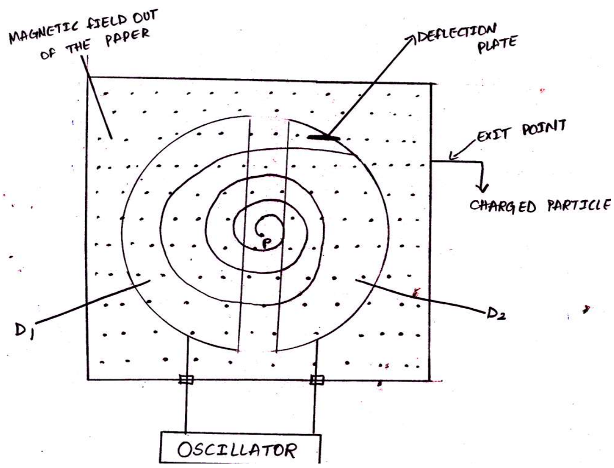
→ To accelerate protons, deutrons and α-particles.

→ To bombard nuclei with energetic particles and study the resulting nuclear reactions.

→ To implant ions into solids and modify them.

→ To implant ions into solids and modify their properties or even synthesis new materials.

→ In hospitals to produce radiioactive substances which can be used in diagnosis and treatment.



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MAGNATISM AND MATTER

31. A Derive an expression for the axial field of a solenoid of radius 'r', containing 'n' turns per unit length and carrying 'i'.

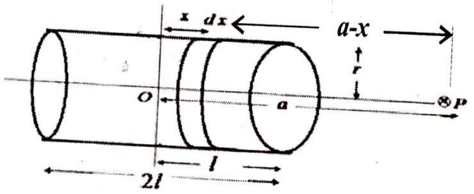
A. **Expression for the axial field of solenoid** : Consider a selenoid consisting of 'n' turns per unit length and carrying current 'i'. Let the length of the solenoid be 2l and 'r' be its radius. Consider a point P at a distance 'a' from the centre 'O' of the solenoid.

Consider a circular element of thickness dx of the solenoid at a distance 'x' from the centre. It consists of ndx turns. The magnitude of the field at the point P due to the circular elements is given by

$$dB = \frac{\mu_0 ndxir^2}{2\left[(a-x)^2 + r^2\right]^{3/2}}$$

The total magnetic induction is obtained by integrating between the limits x =- ℓ to x = +1

$$\therefore B = \frac{\mu_0 nir^2}{2}\int_{-1}^{+1}\frac{dx}{\left[(a-x)^2 + r^2\right]^{3/2}}$$



If r >>a and r >> ℓ , then $[(a-x)^2+r^2]^{3/2} \approx a^3$

$$\therefore B = \frac{\mu_0 nir^2}{2a^3}\int_{-1}^{+1}dx = \frac{\mu_0 ni}{2}\frac{2\ell r^2}{a^3}$$

But the magnetic moment of the solenoid M = n(2 ℓ)I(πr^2)

$$\therefore B = \frac{\mu_0}{4\pi}\frac{2M}{a^3}$$

32. Compare the properties of Para, Dia and Ferromagnetic substances.

A. Properties of Para, Dia and Ferromagnetic substances.

S.No	PARAMAGNETIC	DIAMAGNETIC	FERROMAGNETIC
1.	They are freely attracted by a magnetic	They are freely repelled by a magnet.	They are strongly attracted by a magnet.
2.	Magnetized freely in the Direction of magnetizing field	They are freely magnetized in opposite direction to the magnetizing field	Magnetized strongly in the direction of magnetizing field
3.	They align with their length along direction magnetic field	They align with their length perpendicular to the magnetic field	They align with their length along, the direction magnetic field
4.	They move from weaker to stronger part of the magnetic field	They move from stronger part of the magnetic field to the weaker part of the magnetic field	They move from weaker to stronger part of the magnetic field.
5.	Magnetic permeability is greater than 1 and positive	Magnetic permeability is less than 1 and positive	Magnetic permeability is much greater than 1.
6.	x is small and positive Ex. Aluminium, plantinum Maganese, Chromium	x is small and negative Ex. Bismuth, Copper, lead Silicon, water, glass etc.	x is high and positive. Ex. Iron, Cobalt, Nickel and alloys like alnico.

33. Explain the elements of Earth's magnetic field and draw a sketch showing the relationship between the vertical component, horizontal component and angle of dip.

A. Magnetic Elements of Earth's magnetism are three types : The magnetic field of earth, at a place can be completely characterised by three parameters given as

a) Magnetic declination.

b) Magnetic dip or inclination.

c) Horizontal components of earth's magnetic field.

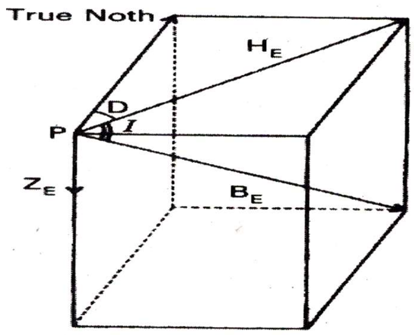
a) Magnetic declination (D) :- It is defined as the angle between the magnetic meridian and geographical meridian measured in the horizontal plane.

b) Magnetic dip or inclination (I) :- It is defined as the angle made by the resultant magnetic field of the earth at a place with the horizontal. At the magnetic poles of the earth the value of dip is 90^0. At the magnetic equator, value of dip is 0^0.

c) Horizontal component of Earth's magnetic field (H_E) :- It is the component of earth's total magnetic field along horizontal direction in the magnetic meridian. It is denoted by H_E.

Relation between the vertical component horizontal component and angle of dip

From the figure, we can find $H_E = B_E \cos I$ and $Z_E = B_E \sin I$ where H_E and Z_E are horizontal and vertical component of earth's magnetic field.



Now we can write $B_E = \sqrt{H_E^2 + Z_E^2}$ and $\tan I = \frac{Z_E}{H_E}$

ATOMS

34. Derive an expression for potential and kinetic energy of an electrolyte in any orbit of a hydrogen atom according to Bohr's atomic model. How does P.E change with increasing 'n'?

A. Expression for potential energy: An electron possesses electrostatic potential energy because it is found in the field of nucleus. Potential energy of electron in n^{th} orbit is given by

$$P.E. = \frac{1}{4\pi\varepsilon_0}\frac{(Ze)}{r}$$

But,

$$r = \frac{n^2h^2\varepsilon_0}{\pi me^2Z} \text{ and for hydrogen atom } Z = 1,$$

$$P.E = -\frac{me^4}{4\pi\varepsilon_0^2n^2h^2}$$

Expression for kinetic energy : Kinetic energy is due to the motion of electron in the orbit. The coulomb's force of attraction between electron and the positively charged nucleus provides necessary untripetal force.

$$\frac{mv^2}{r} = \frac{1}{4\pi\varepsilon_0}.\frac{Ze^2}{r^2}$$

or $$mv^2 = \frac{1}{4\pi\varepsilon_0}.\frac{Ze^2}{r}$$

or $$\frac{1}{2}mv^2 = \frac{1}{8\pi\varepsilon_0}.\frac{Ze^2}{r}$$

But, $r = \frac{n^2h^2\varepsilon_0}{\pi me^2Z}$ and for hydrogen atom Z = 1.

$$K.E = \frac{me^4}{8\varepsilon_0^2n^2h^2}$$

Dependence of P.E on 'n' :

$$PE \propto \left(-\frac{1}{n^2}\right)$$

As 'n' increases, P.E. becomes less negative and hence P.E. increases.
As the value of 'n' increases, the potential energyof the electron increases.

35. What are the limitations of Bohr's theory of hydrogen atom?

A. Limitations of Bohr's model:

i. Bohr's model is applicable to only single electron system (ie.) H_2 - atom.

ii. This model could not explain the five structure of spectral lines. It does not explain wave particles of electrons.

iii. It could not explain why hte orbits are circular when elliptical orbit are also possible.

iv. Bohr's model could not explain the binding of atoms into molecules.

v. No justification was given for the principle of quantization of angular momentum.

36. Explain the different types of spectral series.

A. **<u>Spectral series :</u>** The wavelength of the different members of the series for hydrogen atom can be found form the following relation.

$$\bar{v} = \frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

This relation explains the complete spectrum of hydrogen. A detailed account of the important radiations are listed below.

<u>Different type sof spectral lines.</u>

i. **<u>Lyman Series :</u>** When electron jumping on to the first orbit from higher energy levels than that series of spectral lines are called lyman series.

In Lyman series $\frac{1}{\lambda} = R\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$ where n = 2, 3, ...etc.

These lines are in ultraviolet region.

ii. **<u>Balmer Series :</u>** When electron jumping on the second orbti from higher energy levels than that series of spectral lines are called Balmer series.

$$\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{n^2}\right] \text{ where n = 3, 4, ...etc.}$$

iii. **<u>Paschen Series :</u>** When electron jumping on to the third orbit from higher energy levels then that series of spectral lines are called Paschen series.

$$\frac{1}{\lambda} = R\left[\frac{1}{3^2} - \frac{1}{n^2}\right] \text{ where n = 4, 5, ...etc.}$$

These spectral lines are in near infrared region.

iv. **<u>Brackett Series :</u>** When electron jumping on to the fourth orbit from higher energy levels then that series of spectral lines are called Brackett series.

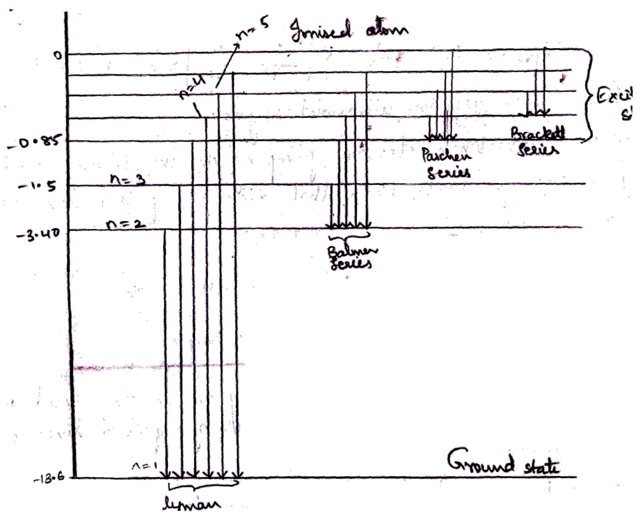
$$\frac{1}{\lambda} = R\left[\frac{1}{4^2} - \frac{1}{n^2}\right] \text{ where n = 5, 6,.............etc.}$$

These spectral lines are in middle infrared region.

v. **<u>Pfund Series :</u>** When electron jumping on to the fifth orbit from higher energy levels then that series of spectral ines are called Pfund series.

$$\frac{1}{\lambda} = R\left[\frac{1}{5^2} - \frac{1}{n^2}\right] \text{ where n = 6, 7, ...etc.}$$

These spectral lines are in for infrared region.



37. Write a short note on Debroglie's explanation of Bohr's seond postulale of quantization.

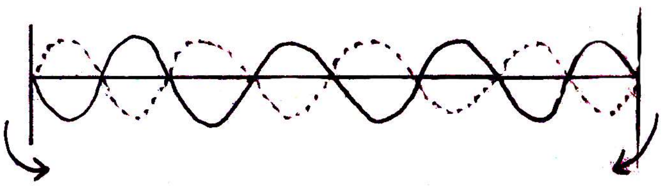
A. Debroglee's explanation of Bohr's second postulate of quantization:

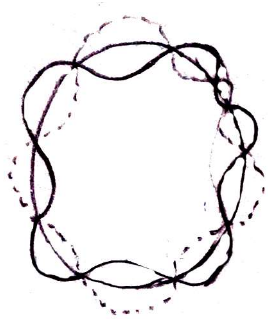
The seond wve associated with the moving particle is called matter, wave and the wavelength is called the De broglie wavelength. For a photon, momentum $P = \frac{E}{c}$ (or) $\frac{hv}{c}$ ($\therefore E = hv$). If λ is the wavelength of the wave, $p = \frac{h}{\lambda}$ ($\therefore v = \frac{c}{\lambda}$) (or) $\lambda = \frac{h}{p}$

De broglie tried to explain Bohr's criterion to select the allowed orbits in which angular mometnum of the electron is an integral multiple of $\frac{h}{2\pi}$. According to his hypothesis, an electron revoling around nucleus is associated with certain wavelengths 'λ' which depends on its momentum mv. It is given by

$$\lambda = \frac{h}{mv} = \frac{h}{p}$$

In an allowed orbit an electron can have an integral mutliple of this wavelength. That is the n^{th} orbit consist of n complete de-broglie wavelengths i.e. $2\pi r_n = n\lambda_n$, where r_n is the radius of n^{th} orbit and λ_n is the wavelength of n^{th} orbit $\lambda_n = \frac{2\pi r_n}{n}$ (or) $\lambda_n = \frac{2\pi}{n}(0.53 \times n^2)\,A^0$ (or) $\lambda_n = 2\pi r_1\, n\, A^0$, where r is radius of first orbit of figure (a) shows the waves on a string having a wavelength related tothe length of the string allowing them to interfere constructively. If we imagine the string bent into a closed circle we get an idea of how electrons in circular orbits can intefere constructively as shown in figure (b). If the wavelength does not fit intothe circumference, the elecgtron interferes destrictively and it cannot exist in such an orbit.

a.


b.


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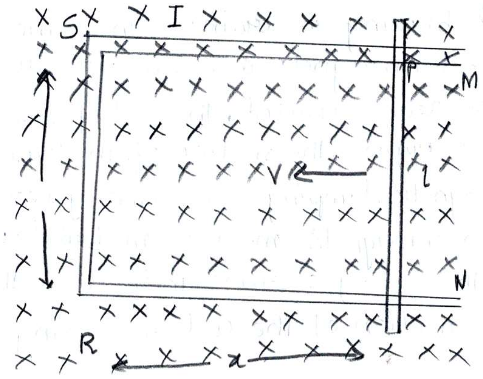
ELECTROMAGNETIC INDUCTION

38. Obtain an expression for the emf induced across a conductor which is moved in a uniform magnetic field which is perpendicular to the plane of motion.

A.



Let us consider a striaght conductor 'PQ' moving in uniform magnetic field of induction $\vec{B}$ let the straight conductor pQ is free to move on smooth parallel side of a U shaped conductor .

We know that e = $\frac{d\phi}{dt}$

But $\phi = BA$ $(\theta = 0^0)$

$$e = \frac{-d}{dt}(BA)$$

But $A = \ell x$

$$e = \frac{-d}{dt}(B\ell x)$$

$$e = B\ell \cdot \frac{dx}{dt} \quad e = B\ell v \quad e = \ell\left(\vec{V} \times \vec{B}\right)$$

39. Describe the ways in which eddy current are used to advantage.

A. Eddy current are used to advantage in

i. **<u>Magnetic braking in trains :</u>** In some electric trains electromagnets are situated above the rails when these are activated, the eddy current induced in the rails oppose the motion of the train.

ii. **<u>Electromagnetic damping :</u>** In some galvanometers core is made of nonmagnetic metallic material. when the coils oscillates, the eddy currents induced in the core oppose the motion of the coil and bring it to rest quickly.

iii. **<u>Induction FUrnance :</u>** In an induction, a metallic block to be melted is placed in high frquency chaning magnetic field. Strong eddy currents are induced in the block. Due to the high resistance of the metal, a large amount of heat is produced in it. This heat ultimately melts the metalic block.

iv. **<u>Electric power meters :</u>** The shiny metal disc in the electric power meter rotates due to eddy currents. Electric currents induced in the disc by magnetic fields produced by sinusoidally varying currents in the coil.

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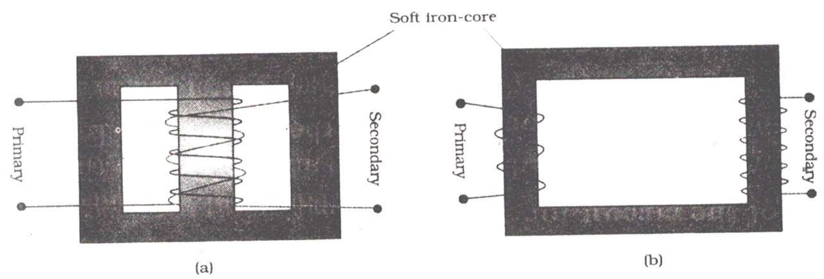
ALTERNATING CURRENT

40. State the principle on which a transformer works. Describe the working of a transformer with neccesary theory.

A. **Transformer** :- A transfromer converts high voltage low currents into low voltage high currents and vice-versa. Transformer works only for AC.

Principle :- A transformer works on the principle of mutual inductance between two coils linked by a common magnetic flux.

Construction :- A transformer consists of two mutually coupled insulted coils of wire wound on a continous iron core. One of the coils is called primary coil and the other is called secondary coil. The primary is connected to an AC e.m.f and secondary to a load. Due to this alternating flux linkage, an e.m.f is induced in the secondary due to mutual induction.



Working :- Let N_P and N_S be the number of turns in the primary and secondary coils respectively The induced e.m.f's produced in primary and secondary coils are given by

$$V_P = -N_P\left(\frac{d\phi}{dt}\right) \text{ and } VS = -N_s\left(\frac{d\phi}{dt}\right),$$

Hence $\frac{V_s}{V_p} = \frac{N_s}{N_p}$

Where v_p and v_s are the primary and secondary voltages.

If the efficiency of the transformer is 100%, then $V_s i_s = v_p i_p$ or $\frac{i_p}{i_s} = \frac{V_s}{V_p} = \frac{N_s}{N_p}$ ($\because$ Power = iv) $\frac{N_s}{N_p}$ is called transformer ratio. If Ns > Np, then it is called a step-up transformer, If Ns < Np, then it is called a step-down transfromer.

ELECTROMAGNETIC RAYS

41. What is Greenhouse effect and its cotribution towards the surface temperature of earth?

A. **Greenhouse effect** :- The earth surface is a source of thermal radiation as it absorbs received from sun. The wave lengh of this radiation lies in the infrared region. But a large portion of this radiation is absorbed by greenhouse gases like Co_2, CH_4, N_2O, O_3. This heats up the atmosphere which in turn gives more energy to earth. As a result the surface of earth becomes warmer. This increases the intensity of radiation from the surface. This process is repeated until no radiation is available for absorption. The net result is heating up of earth's surface and atmosphere. This is known as greenhouse effect. without the green house effect the emperature of the earth be -18^0 C.

Concentration of greenhouse gases has enhanced due to human activities. As a result the average temeprature of earth has increased by 0.3^0C to $0.6\ ^0$C By the middle of the next century the temperature may be increased by 1^0C to 3^0C. This global warming may cause problems for human life, Plants and animals.

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NUCLEI

42. Define half life period and decay constant for a radioactive substance. Deduce the relation between them.

A. **Half life period ($T_{1/2}$) :** Time interval in which the mass of a radioactive substance or the number of it's atom reduces of half of it's initial value is called the half life of the substance.

Decay Constant : Decay constant is defined as the ratio of its instant rate of disintegration to the number of atoms present at that time. $\lambda = \frac{dN/dt}{N}$.

Relation : If N = $\frac{N_0}{2}$ then t = $T_{1/2}$

Hence from $N = N_0 e^{-\lambda 1} \Rightarrow \frac{N_0}{2} = N_0 e^{-\lambda(T_{1/2})} \Rightarrow T_{1/2} = \frac{\log_e 2}{\lambda} = \frac{2.303 \log_{10}^2}{\lambda} = \frac{0.693}{\lambda}$.

43. Define average life of a radioactive substance. Obtain the relation between decay constant and average life.

A. **Average life :** It is the ratio of total life of all the atoms of a given sample to the total number of atoms present in the sample.

Relation between decay constant and average life: Let N_0 be the number of atoms present at t = 0 in the substance. Let N be the number of atoms present in a time t. Let dN be the number of atoms disintegrated in a time interval of t and t + dt i.e., each of dN atoms lived afor a time t.

Total life of dN atoms = t dN

$$\text{Average life } (\tau) = \frac{\text{Total life of all atoms}}{\text{Number of atoms}} = \frac{\int_0^\infty t\,dN}{N_0}$$

But $\frac{dN}{dt} = \lambda N \Rightarrow dN = -\lambda N \; dt$

$$\tau = \int_0^\infty \frac{-t\lambda N dt}{N_0} \Rightarrow \tau = \int_0^\infty \frac{-t\lambda N_0 e^{-\lambda t} dt}{N_0} \qquad \text{Average life } \tau = \frac{1}{\lambda} \left[\because \int_0^\infty -\lambda t N e^{-\lambda t} dt = \frac{1}{\lambda}\right]$$

But $T_{1/2} = \frac{0.693}{\lambda} \Rightarrow \lambda = \frac{0.693}{t_{1/2}}$

$\tau = \frac{T_{1/2}}{0.693} \Rightarrow \tau = 1.44 t_{1/2}$.

44. Distinguish between nuclear fission and nuclear fusion.

A.

Nuclear Fission	**Nuclear Fusion**
1) The process of splitting of a heavier nucleus into two or more stable fragements	1) Fusing two lighter nuclei into a heavier nucleus, to attain stability.
2) Each fission gives about 200 MeV of energy equivalent to mass defect.	2) Each fusion gives about 28 MeV of equivalent to the mass defect.
3) Energy released per nucleon is less and equal to 0.85 MeV.	3) Energy released per nucleon is more and equal to 6 MeV.
4) This is the principle of atom bomb.	4) This is the principle of hydrogen bomb.
5) Fission takes place at room termperature.	5) Fusion takes place at high temperature.
6) Energy produced by nuclear reactors is by fission.	6) Energy released by stars and sun is by fusion.

* * * * * * * * *

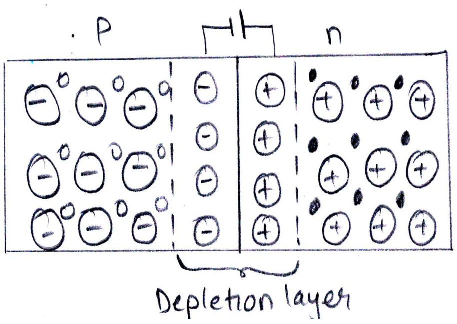
SEMICONDUCTOR ELECTRONICS

45. What are n-type and p-type semiconductors? How is a semiconductor junction formed?

A. **n-type Extrinsic Semiconductor:** Pentavalent substance like arsenic, phosphorus, antimony, bismuth are dopped in a pure semiconductor. Arsenic is called donor impurity. Majority charge carriers are electrons and minority charge carriers are holes. Hence it is called N-type semiconducotr, Fermi energy level is nearer to the conduction band.

p-type extrinsic semiconductor : Trivalent substance like boron, aluminium, gallium, indium etc are dopped in a pure semi-conductor. Boron is called acceptor impurity. Majority charge carriers are holes and minority charge carriers are electrons and hence it is called p-type semi-conductor. Fermi energy level is near to the valence band.

p-n junction : A p-n junction is formed by doping n-type on one side and p-type on the other side of a pure semi-conductor. p-side of semiconductor contains excess holes and n-side of semicondudor contains excess of electrons.



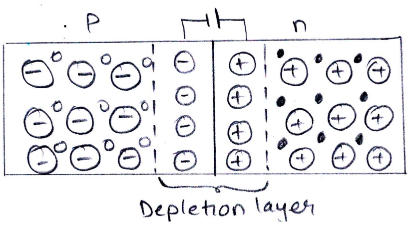
Junction barrier : The electrons from n-side diffuse to p-side and combine with holes there. Similarly, holes from p-side diffuse to into n-side and combines with electrons there. Due to diffusion, positive ion are left over in n-region an dnegative ion are left over in p-region, near the junction. these ions are immobile. Due to the immobile ions on either sides of the juncitons an internal electric field is formed at the junction which is directed from n to p. At p-n junction a neutral region where there are no charge carrier is formed and it is called depletion layer. The potential difference across the barrier prevents diffuse of charge carrier through the junction and it is called potential barrier.

46. Discuss the behaviour of a p-n junction. How does a potential barrier develop at the junction?

A. Depletion layer - Potential barrier :

i. In a p-n junction electrons from n-side diffuse to p-side and combine with holes there. simillarly holes from p-side diffuse into n-side and combines with electrons there.

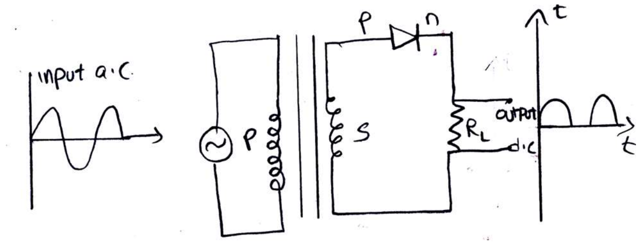
ii. Due to diffusion, positive ions are left over in n-region and negative ions are left over in p-region, near the junction. Due to these immobile ions on either side of the junction an internal electric field is formed at the junction which is directed from n to p. At p-n junction a neutral region where there are no charge carrier is formed and it is called depletion layer. The potential difference accross the barriers prevents diffusion of charge carriers through the junction and it is called potential barrier. The potential barrier depends on the nature of semiconductor doping concentration and temperature of the junction. There is no current in the p-n junction diode in the absence of any external battery.



47. Describe how a semiconductor diode is used as a half wave rectifier?

A. **Rectifier :** Conversion of A.C voltage into D.C voltage is called rectification. A p-n junction diode is used as a rectifier.

Half wave rectifier: In a half wave rectifier a single diode is used. The a.c. from the secondary of the transformer is applied to the diode and a load resistances R_L in series. During the positive half cycle, the diode is forward biased and current flows though the diode and the load resistance. during the negative half cycle, the diode is reverse biased and current doe not flow through the diode. Thus current flows during the positive half cycle only. The output across the load resistance contains. Rectified voltage which is a variable DC.



Efficiency of half-wave rectifier = $\frac{\text{DC power output}}{\text{AC power input}} = \frac{0.406 R_L}{R_L + r_f}$

Where r_f = forward resistance of iode.

R_L = load resistance

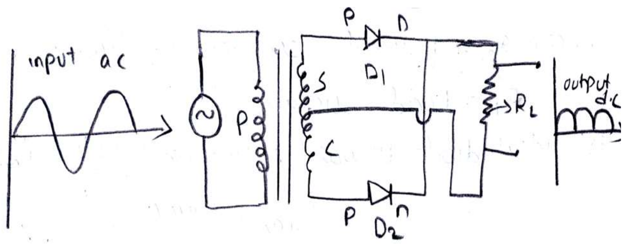
for ideal diode forward resistance $r_f \simeq 0 \Rightarrow m_{max} = m_{max} = 0.406$.

Maximum efficiency of the half-wave rectifier is 40.6%

48. What is rectification? Explain the working of a full wave rectifier?

A. **Rectification :** Conversion of A.C. voltage into D.C votlage is called rectification. A p-n junction diode is used as a rectifier.

Full - wave rectifier : In a full wave rectifier two dioides are used. The secondary of the transformer is centre tapped between diode D_1 & D_2 as shown. Across the common point of n-ends and the central tap C a load resistance R_L is connected. During the positive half cycle of a.c. diode D_1 is forward biased and D_2 as reverse biased. During the negative half cycle of a.c. diode D_2 is forward biased and D_1 reverse biased. Hence current flows through the load resistance R_L during the full cycle of a.c . Thus a full wave of a.c is rectified.



Efficiency of the full - wave rectifier = $\frac{\text{DC power output}}{\text{AC power input}} = \frac{0.812 R_L}{r_f + R_L}$

Where r_f = forward resistance of diode.

R_L = load resistance

for ideal diode forward resistance $r_f \simeq 0 \Rightarrow m_{max} = m_{max} = 0.812$.

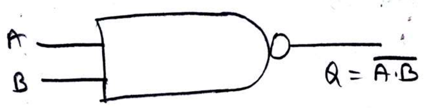
Maximum efficiency of the full-wave rectifier is 81.2%.

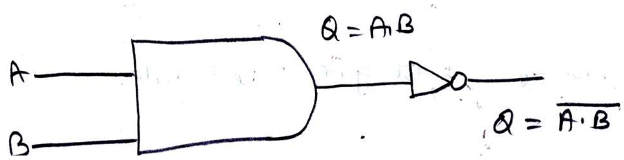
49. Define NAND and NOR gates. Give their truth tables.

A. **NAND Gate:** It has two input terminal and output terminal. The output of a NAND gate is an inversion of the output of an AND gate. If A and B are the input of the NAND gate is output is not truth table of NAND gate.

Input		Output
A	B	Q
0	0	1
1	0	1
0	1	1
1	1	0

The logical function shown by the truth table is written as A NAND B. The out put Q = A.B and the symbol, used for the logic gate is



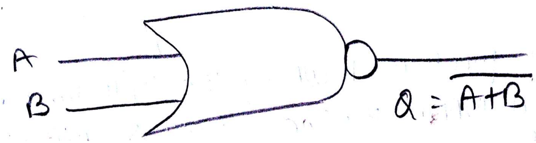


NOR GATE : It has two inputs terminals and one output terminal. A and B are the input of NOR gate output is NOT.

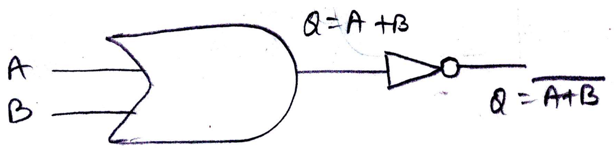
<u>The truth table of NOR gate</u>

Input		Output
A	B	Q
0	0	1
1	0	1
0	1	0
1	1	0

<u>NOR GATE:</u>



NOR gate is inversion of OR gate and diagram in terms of OR gate is



Nor gate = OR gate + NOT gate.

*******_The End_******

V S AQ's (2 MARKS)

Ray Optics and Optical Instruments

1. Define focal length and radius of curvature of a concave lens.

A. Focal Length:- Focal length of concave lens is the distance between optical centre and the principle focus of the lens. Radius of Curvature: Radius of curvature of concave lens is the radius of the sphere from which the lens is separated.

2. What do you understand by the terms 'focus' and principal 'focus' in the context of lenses?

A. Focus:- The beam of light through the lens converse at a point or appears to diverse from a point, this point is called focus. Principal Focus:- The point on the principal axis where all the rays coming from object paralelel to the principal axis are diveraged or coveraged by lens is called principal focus.

3. What is optical density and how is it different from mass density?

A. Optical density:- When a light ray refract one medium to other medium then the ratio of the velocity of light in the refracted medium to the velocity of the light in the incident medium is called optical density. Optical density is different from mass density. Mass density is the mass per volume. Optical density explains the transparent nature of the medium. For example mass density of turpentine is less than that of water, but its optical density is higher.

4. What are the laws of reflection through curved mirrors?

A. Laws of reflection:-

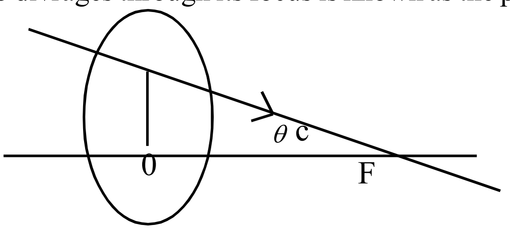
i) The incident ray, reflected ray and normal to the reflecting surface at the point of incident all lie in the same plane.

ii) The angle of incidence is equal to the angle of reflection i.e. $\angle i = \angle r$

5. Define power of a convex lens. What are its units?

A. Power of Convex lens:- The tangent angle of deviation of a light ray, which is coming from a unit height from the centre of lens and converges (or) appears to divrages through its focus is known as the power of convex lens

Power (P) = tan θ = $\frac{1}{F}$, units ; dioptre .



6. A Concave mirror of focal length 10cm is placed at a distance 35 cm from a wall. How for from the wall should an object be placed so that its real image is formed on the wall?

A. Focal length = 10cm

Image distance = 35 cm

Object distance from pole mirror U=?

$$\frac{1}{F} = \frac{1}{\mu} + \frac{1}{v} \Rightarrow \frac{1}{U} = \frac{1}{V} + \frac{1}{F} \Rightarrow u = \frac{Fv}{v-f}$$

$$= \frac{10 \times 35}{35-10} = \frac{350}{25} = 14\,cm$$

From the wall. the distance of object =35-14=21 c.m.

7. Concave mirror produced an image of a long vertical pin, placed 40 cm from the mirror, at the position of the object, Find the focal length of the mirror?

A. Given that U=V=-40 cm

$$\frac{1}{F}=\frac{1}{u}+\frac{1}{v}=\frac{1}{-40}+\frac{1}{-40}\;:\;-1 \qquad = \frac{-20}{cm}$$

= -20 c.m

8. A small angled prism of 4° diviates a ray through 2.48. Find the refractive index of the prism.

A. $d=(n_{21}-1)A \Rightarrow 2.48=(n_{21}-1)4 \Rightarrow n_{21}=1.62$

Q-9. What is dispersion ? Which colour gets relatively more dispersed?

A. The Phenomenon of splitting of white light into seven constituent colours (VIBGYOR) is known as dispersion. violet colour is relatively more disperson.

10. The focal length of a concave lens is 30 cm where should an object be placed so what its image is 1/10 of its size?

A) F=30 cm , V=$\frac{U}{10}$

$$\frac{1}{V}-\frac{1}{U}=\frac{1}{F}$$

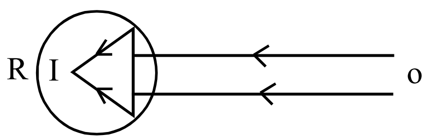
$$\frac{10}{U}-\frac{1}{U}=\frac{1}{-30}\Rightarrow\frac{9}{U}=\frac{1}{-30}$$

$$\Rightarrow U=-270\text{cm}$$

Q-11. What is myopia? How can it be corrected?

Ans: Myopia:- If the image of distant object is focussed before the retina then it cannot be seen clearly. This defect of eye is called myopia.

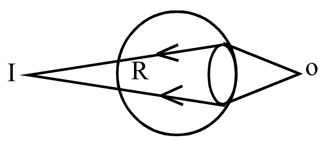
correction:- This defect can be corrected by using concave lens.



Q-12. What is hypermetropia? How can it be corrected?

Hypermetropia:- If the image of near object is formed behind the retina then it cannot be seen clearly. This defect of eye is called hypermetropia.

Correction:- This defect can be corrected by using. Convex lens.



Electric Charges and Fields

Q-13. What is meant by the statement that ' Charge is quantized?

Ans: The Minimum charge that may be transferred from one body to the other is equal to the charge of electron.($1.6x10^{-19}$ C). The charge is available in multiples of charge on elctron i.e.; $Q=\pm ne$ Hence charge is said to be quantized.

Q-14. Repulsion is the sure test of charging than attraction. Why?

Ans: Positively charged body can attracts both negatively charged and neutral bodies. But positively charged body can only repel another positively charged body.
Hence repulsion is sure test of electrification.

Q-15. How many electrons constitute 1C of charge?

Ans: Charge of electron $e=1.6x10^{-19}$ C

$$\Rightarrow n = \frac{1}{1.6x10^{-19}} = 6.25x10^{18} \text{electrons}$$

16) What happens to the weight of a body when it is charged posively?

Ans: When a body is charged positively, its weight decreases due to the removal of electrons even though the effect is small.

17) What happens to the force between two charges if the distance between them is
a) Halved b) doubled...?

Ans:

$$a) F \propto \frac{d}{d^2}$$

$$a) \frac{F2}{F1} = \left[\frac{d}{d_2}\right]^2 \Rightarrow \frac{F2}{F1} = \left[\frac{d}{d/2}\right]^2 \Rightarrow \frac{F2}{F1} = \left[\frac{2d}{d}\right]^2$$

$$\frac{F2}{F1} = 4 \Rightarrow F2 = 4F1$$

$\therefore$ The force between the charges becomes four times.

$$b) \frac{F2}{F1} = \left[\frac{d1}{d_2}\right]^2 \Rightarrow F2 = \frac{F1}{4}$$

$\therefore$ The force is reduced to $\frac{1th}{4}$ of its original value.

18) The elctric lines of force do not intersect. Why?

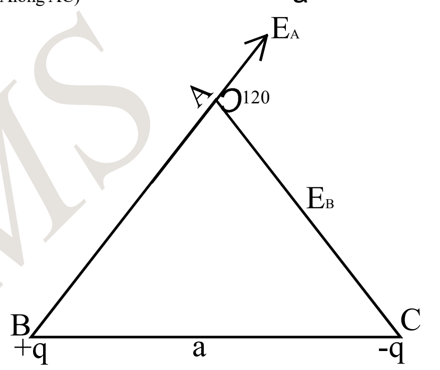
Ans: The tangent drawn to electric lines of force gives the direction of electric field at that point. If the electric lines of force intersect, then at the point of intersection electric field will act in two different direction, which is not possible. Hence Electric lines of force do not intersect.

19) Consider two charges +q placed at B and C of an equilateral triangle ABC. For this system, the total charges is zero. But electric field at A which is equidistant from B and C is not zero. Why ?

Ans : Net charge = +q-q=0

Let 'a' be the side of the triangle.

The electric intensity at a due its the charge +q is given by $E_{\text{(Along AC)}} = \frac{1}{u\pi\varepsilon o}\frac{q}{a^2}$



The angle between these intensities is 120"

The resultant intensity is given by $E = \frac{1}{u\pi\varepsilon o}\frac{q}{a^2}$ (// to BC gram A)

20) Electrostatic field lines of force do not form closed loops. If they form closed then the work done in moving a charge along a closed path will not be zero. From the above two stalements can you guess the nature of electrostatic force?

Ans: Electrostatic force is a conservative froce (constant)

Q-21. State Gauss's law in electrostatics

Ans: Gauss's Law: " The electric flune (ϕ) = through any closed surface is equal to $\frac{1}{\varepsilon 0}$ times the net charge enclosed by the surface" $\phi = \oint \vec{E} \cdot \vec{ds} = \frac{1}{\varepsilon 0} q$

This is integral form of Gausse's law, Here ε_o is the permittivity of free space.

Q-22. When will be the electric flux negative and is it positive?

Ans: For a closed body, inward flux is taken to be negative and outward.

Flux is taken to be positive.

WAVE OPTICS

Q-23. What is fresnel distance?

Ans: Fresnel Distance: The distance beyond which divergence of beam of width 'a' become significant is called fresnel distance.

Fresnel distance $Z \approx \frac{a^2}{\lambda}$

Q-24. Give the Justification for validity of ray optics?

Ans: $Z_F \leq \frac{a^2}{\lambda}$ is the validity of ray optics.

If the distance between aperture and screen is much smaller than Z_F *i.e.,* $\frac{a^2}{\lambda}$ diffraction pattern cannot be observed so ray optics is applicable.

Q-25. What is Polarization of light?

Ans: Polarization of light:- The Phenomena of restricting the vibration of a transverse wave into a particular direction is called polarization. Polarization establishes the fact that the waves are transverse in nature.

Q-26. What is Malus law ?

Ans: Malus Law: The Intensity of polarised light transmitted through the analysis varies as the square of the cosine of the angle between the plane of transmission of the polarised and the analyser $I=I_o \cos^2\theta$. Where θ=angle between the axis of the polarizer and analyser.

Q-27. Explain Brewsters Law.

Ans: Brecuster's Law : It states that "The tangent of the angle of polarisation is equal to the refractive index of the reflecting medium". $\mu = \tan i_p \longrightarrow$ angle of polarisation.

Q-28. When does a monochromatic beam of light incident on a reflective surface gets completely transmitted?

Ans:- When the monochromatic beam of light incident on the surface of the prism at brewsters angle. Then no reflection and there will be total transmission of light.

ELECTROSTATICS POTENTIAL AND CAPACITANCE

Q-29. Can there be electric potential at a point with zero electric intensity ? Give an example.

Ans: Yes. There can be exist electric potential with zero electric intensity.

example: inside a charged spherical conductor, electric intensity is zero but there electric potential is not zero

Q-30. Can there be electric intensity at a point with zero electric potential? Give an example.

Ans: Yes. There an exist electric intensity with zero electric potential.

Example: When two dissimilas charges of some magnitude are separated by a certain distance at a mid point potential is zero. But electric field strength is not zero.

ELECTRIC POTENTIAL AND CAPACITANCE.

Q-31. What are meant by equipotential surface?

Ans: Equipotential surface: Equipotential surface in an electric field is a surface on which the potential is same at every point

(or)

The locus of all points which have the same electric potential is called equipotential surface. Work done in taking a charge from one point to other is zero

.

Q-32. Why is the electric field always at right angles to the equipotential surface? Explain.

Ans: The electric field always is right angles to the equipotential surface. If not, it would have a nonzero component along the surface. Hence work has to be done to move a test charge against this component. This is against to the definition and hence the electric field always at right angles to the equipotential surface.

33. Three capacitors of capacitances $1\mu F, 2\mu F$ and 3μ F are connected in parallel?

a) What is the ratio of charges? b) What is the ratio of potential differences?

Ans: (a) In Parallel combination potential is constant

Q1:Q2:Q3=C1:C2:C3 ($\therefore Q1 : Q2 : Q3 = 1 : 2 : 3$

b) As potential is constant ratio is V1:V2:V3=1:1:1.

34. Three capacitors of capacitances $1\mu F, 2\mu F, 3\mu F$ are connected in series.

(a) Ratio of charges (b) Ratio of Potential differences?

Ans: (a) In Series combination, charge is same on all capacitors. Q1:Q2:Q3=1:1:1

(b) $V1 : V2 : V3 = \frac{1}{1} : \frac{1}{2} : \frac{1}{3} = 6 : 3 : 2$

35. What happens to the capacitance of a parallel plate capacitor. If area of its plates is doubled?

Ans: Capacity of parallel plate capacitor $C = \frac{\varepsilon o A}{d}$

$$\frac{C2}{C1} = \frac{A2}{A1} = \frac{2A}{A} = 2$$

$$\therefore C_2 = 2C1$$

Hence the capacity becomes doubled.

36. The dielectric strength of air is $3x10^6$ Vm^{-1} at certain pressure. A parallel plate capacitor with air in between the plate has a plate seperation of 1cm. Can you change the capacitor to $3x10^6 V$?

$$\Rightarrow E = \frac{V}{d} \Rightarrow V = Ed = 3x10^4 \text{ Volts}$$

Hence, the capacitor cannot be charged to $3x10^6 V$.

DUAL NATURE AND RADIATION MATTER

37. What are cathode rays?

Cathode rays:- cathode rays are a stream of fast moving electrons in a discharge tube, when the pressure of the gas is reduced to 0.01mm of Hg and high potential differences about 10 kv is applied between the electrodes.

38. What important the fact that Millikans experiment established?

Importance of Millikan's experiment:- Millikan's experiment established that electric charge is

39. What is work function?
Work function:- It is defined as the minimum amount of energy required to liberate an electron from the given photo. surface. It depends only on nature of metal surface.
40. What is photo electric effect?
Photo Electric effect:- When suitable wavelength of light is incident on alkali metals, they emit the electrons from their surfaces. This phenomemon is called photo electric effect.
41. Give Examples of "Photosensitive substances".
Why are they called So?
Ans: Photosensitive Substances:- Some Alkali metals like lithium, sodium, potassium etc; are examples of photosensitive substances.
They are sensitive even for visible light and emits electrons when they are illuminated by light.
42. Writedown Einstein's photoelectric equation.
Ans:- Einstein's photo electric equation:- Einstein's applied the law of conservation of energy to the photon absorption by an electron in metal

$$h\upsilon = \phi_o + \frac{1}{2}MV^2 \Rightarrow \frac{1}{2}MV^2 = h\upsilon - \phi_o$$

43. Write down the de-broglie's relation and explain the terms there in.
Ans: The ratio between the plank's constant (h) and the momentum of the particle (P) is called de Broglic wavelength

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Where V=Velocity of the particle
and m=mass of the particle

Q-44. State Heisenberg's Uncertainity principle.
Ans: Heinsenberg's Uncertainity principle:- According to Heisenberg's principle:- According to Heisenberg's Uncertainity principle, it is impossible to measure simultaneously both the position and the momentum of the particle Let ΔX *and* ΔP be the Uncertainity in the simultaneous measurement of the position & momentum of the particle, then

$$\Delta X \Delta P \approx h;$$

Where $\hbar = \frac{h}{2\pi}$ and h=6.63×10^{-34} J-S is the plank's constant

Magnetism and Matter:
Q-45. A Magnetic dipole placed in a magnetic field experience a net force. What can you say about the nature of the magnetic field?

Ans: When a magnetic dipole is placed in a non-uniform magnetic field, then it experiences a net forced and torque. Hence the magnetic dipole experiences both translatory and rotatory motions.

Q-47. What happens to the compass needles at the earth's poles?
Ans:- At the Earth's poles the horizontal component of Earth's magnetic field is zero. Hence the compass needles align in any direction.

Q-47. What do you understand by the magnetisation of a sample?
Ans:- Magnetization of sample:- Magnetisation of a sample 'M' is defined as the net magnetic moment per unit volume.

$\frac{m}{v}$ 'M' is a vector with units Am^{-1}

Q-48. What is the magnetic moment associated with a solenoid?

Ans: The Magnetic moment of a solenoid M=NIA, $M = n(2l)I(\pi a^2)$ Where 'a' is the radius of the solenoid, 'n' is no of turns per unit length, 2l is length of solenoids, I is current.

Q-49. What are the units of magnetic moment, magnetic induction and magnetic field?
Ans:- Magnetic moment Am^{-2} (or) JT^{-1}
Magnetic induction A/m (or) Tesla (or) Gauss
Magnetic field A/m (or) Tesla

Q-50. Magnetic lines form continous closed loops why?
A) . Magnetic lines move outside of the magnet in its field from N-Pole to S-pole and moves inside of the magnet from S-pole to N-pole Hence magnetic lines are the continous closed loops.

Q-51. Define Magnetic declination?
A) It is Defind as the acute angle between the magnetic meridians and geographical meridian at a place is called magnetic declination.

Q-52. Define Magnetic inclination or angle of dip?
A) It is the angle between the direction of earth magnetic field and the horizontal component of earth's magnetic field is called magnetic inclination (OR) angle of dip.

Q. Classify the following materials with regard to magnetism : Manganese, Cobalt, Nickel, Bismuth, Oxygen and copper?
Ans: Ferro magnetic materials : cobalt, nickel
Paramagnetic materials : Manganese, Oxygen
Dia Magnetic materials : Copper, Bismuth

Moving Charges and Magnetism

Q-53. A Circular coil of radius 'r' having N turns carries a current 'i' what is its magnetic moments.

Ans: Magnetic moment ofthe coil M=n i A $M = niA = ni\pi r^2$ M is along the axis of the coil A is area of the coil.

Q-54. What is the force on a conductor of length 'l' carrying a current '*i*' placed in a magnetic field of induction B? When does it become maximum?
Ans:- The force on a conductor of Length 'l' carrying current 'i' when it is placed in a magnetic field of induction B is given by F=Bil $\sin\theta$.

The force is maximum when $\theta = 90^{\circ}$

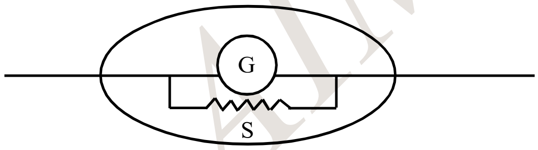
$\underline{F} = Bil \sin 90^{\circ} = Bil$

Q-55. distinguish between ammeter and voltmeter.

Ammeters	Voltmeter
i) A small resistance connected in parallel to a galvanometer constitues moments	i) A high resistance connected in series to a galvanometer constitutes voltmeter.
ii) Ammeters is a device used to measure current in amperes.	ii) Voltmeter is a device and to measure potential difference in volts
iii) Ammeter is always connected in series in a circuit.	iii) Voltmeter is always connected in parallel in circuit.
iv) The resistance of an ammeter is low.	iv) The resistance of an voltmeter is very large.

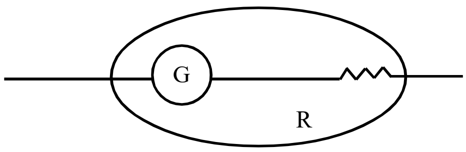
56) How do you convert a moving coil galvanometer into a ammeter

A) MCG can be converted into ammeter by connnecting a low resistance in parallel to it.



Q-57. How do you convert a moving coil goluanometer into a voltmeter?

A) MCG can be converted into voltmeter by connecting a high resistance in series to it



Current Electricity:

Q-58. Why is manganin, used for making standard resisters?

A) Temperature Co-effiecient of resistance of manganin is very less. So its resistance is almost constant over wide range of temperature. Due to this reason manganin is used to prepare standard resistors.

Q-59. The sequance of bonds marked on a carbon resistor all : red, red, red, silver. What is its resistance of tolerance?

A) Resistance : 22×10^2

Tolerance : $\pm 10\%$

Q-60. Write the colour code of a carbon resistor of resistance 23 Kilo ohms?

RC 23 Kilo Ohms $= 23 \times 10^3$ ohms

Colour code: Red, Orange, Orange

Q-61. Why are household appliances connected in parallel?
Ans: If the house hold appliances are connected in parallel, the potential difference across each is same as that of applied voltage. If one of the appliance is fused. The remaining appliances will continue to work because applied voltage is not effected.

Electromagnetic Induction

Q-62. Define magnetic flux:
Ans: Magnetic flux: The Total number of magnetic lines of force passing through a normal surface placed in a magnetic field is called magnetic flux.

Magnetic flux $\varnothing = \vec{B}.\vec{A} = BACOS\theta$

Where θ is the angle between area vector and the uniform magnetic field $\vec{B}$.

Q-63. State faradays laws of elctromagnetic induction.
Ans: Faraday's Laws:
a) Whenever magnetic flux linked with a coil changes, emf is induced in it.
b) The induced emf is proportional to tthe negative rate of change of magnetic flux linked with the coil.

$\varepsilon \alpha \frac{-d\phi}{dt}$ (or) $\varepsilon = \frac{-d\phi}{dt}$ (Proportionality constant K=I)

For N turns $\varepsilon = -N\frac{d\varnothing}{dt} = -N\frac{\varnothing_2 - \varnothing_1}{t}$

Q-64. State lenz's law.
Ans: lenz law: The direction of induced emf is always such that it tends to oppose the change in the magnetic flux that caused it e= $\frac{d\phi}{dt}$

Q-65. What are eddy currents?
Ans: Eddy currents: When the large magnetic field in a metal changes with time, induced emf is produced which makes metal to move on closed paths these are called eddy currents.

Q-66. Define 'inductance.

Ans: Inductance : The ratio of magnetic flux - linkage to current is called inductance. $L = \frac{Q}{i}$

The S.I unit of inductance is Henry.

Q-67. What do you understand by "Self Inductance."
Ans: Self Inductance
The Production of induced emf in isolated coil due to change in current in the same coil is known as self inductance.

$$e \, x \, \frac{d\varnothing}{dt} \Rightarrow e = \frac{-Ldi}{dt}$$

Where 'L' is constant known as coefficient of self inductance.

Alternating Current :

Q-68. A transformer converts 200v ac into 2000 v ac. calculate the number of turns in the secondary if the primary has 10 turns.
Vp= 200v; vs = 2000 v; Np=10; Ns=?

$\frac{Ns}{Np} = \frac{Vs}{Vp}$ or $\frac{Ns}{10} = \frac{2000}{200} \Rightarrow Ns = 100$

Q-69. What type of transformer is used in a 6V bed lamp?
Ans: A step down transformer is used in a 6V bed lamp?
Q-70. What is the phenomenon involved in the working of a transformer?
Ans: Transformer works on the principle of mutual induction between two coils linked by a common magnetic flux.
Q-71. What is tranformer ratio?
Ans: The ratio of output emf to the input emf in a transformer is called transformer ratio.
This is equal to the ratio between number of turns in the secondary to the number of turns in the primary.

Transformer ratio $\frac{Vs}{Vp} = \frac{\text{Number of turns in secondary (Ns)}}{\text{Number of turns in primary (Np)}}$

Q-72. Write the expression for the reactance of (i) an inductor and (ii) a capacitor
A. i) Inductive reactance $(x_L) = WL$ ii) Capacitive reactance $(xc) = \frac{1}{WC}$
Q-73. What is the phase difference between Ac emf and current in the following pure resistor, pure inductor and pure capacitor.
Ans: a) In pure resistor a.c circuit, there is no phase difference between emf and current.

b) In pure inductor a.c circuit, current lags behind the e.m.f $\frac{\pi}{2}$ radian (or) 90°

c) In pure capacitor a.c circuit, current leads emf by $\frac{\pi}{2}$

Q-74.Define power factor. On which factors does power factor depend?
Ans: Power factor:- Power factor is defind as the ratio of true power to apparent power of an A.C. Circuit.
Q-75. What is meant Wattless component of current ?
Ans: Wattless component of current:
The Power dissipated in the circuit is zero even though a current flowing in the circuit. This current is called wattless current since this current does not perform any work, this current may also be called ideal current. Such a current flows only in purely inductive or in purely capacitive circuits.
Q-76. When does LCR series circuit have minimum impedence?

Ans: When $X_L = X_c$ Or $Lw = \frac{1}{cw}$ then $\tan\varnothing = 0$ or $\varnothing = 0^\circ$

Thus there is no phase difference between current and potential difference therefore, the given LCR ckt is equivalent to a given resistive circuit. The impedence of such LCR circuit is given by Z=R. Which is minimum.
Q-77. What is the phase difference between voltage and current when the power factor in LCR series circuit is unity?

Ans: When the power Cos $\varnothing$ = 1 (or) then $\varnothing = 0^\circ$ Hence the phase difference between voltage and current is 0°.

ELECTROMAGNETIC WAVES:

Q-78. What is the average wave length of X-Ray?

Ans: X-Rays covers the range of wave length from 1 nm to 10^{-3} nm.

Average wavelength $= \frac{1+0.001}{2}$ $\frac{1.001}{2} = 0.5005\text{nm}$

Q-79. Give any one use of infrared rays.

Ans:

1. Infrared rays are used in physical therapy.
2. Infrared rays from sun keeps the earth warm and hence help to sustain life on earth due to green house effect.

Q-80. What happens to electromagnetic radiation if the wave length is doubled, What happens to the energy of photon?

Ans- $E = \frac{hc}{\lambda} \Rightarrow E \alpha \frac{1}{\lambda} \Rightarrow \frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} \Rightarrow \frac{E}{E_2} = \frac{2\lambda}{\lambda} = E_2 = \frac{E}{2}$

the energy of photon reduces to half of its initial value.

Electromagnetic Waves:-

Q-81. What is the principle of production of electromagnetic waves?

Ans: Principle of production of electromagnetic waves:-

According to maxwell, accelerated charges, in perpendicular electric and magnetic fields. produce. Electro magnetic waves. The field change within time and space.

Q-82. What is the ratio of speed of infarred rays and ultraviolet rays in vaccum?

Ans: Both infrared rays and ultraviolet rays travel with speed of light in vaccum. Hence the ratio of their speed is 1:1.

Q-83. What is the relation between the amplitiudes of the electric and magnetic fields in free space for an electromagnetic wave?

Ans:- If E_o and B_o are the amplitudes of the electric and magnetic field then relation is $\frac{E_o}{B_o} = C$

where 'C' is velocity of light in vaccum.

Q-84. What are the applications of microwaves?

Ans: Applications of microwaves: Microwaves are used.

a) in radar and telecommunications.

b) To analyse the fine details of the molecular structure

c) Basing on the microwaves, speed guns are designed which are used to time fast balls, and in Tennis serves and automobiles

d) microwave oven is a domestic appliance to cook of the food items.

Q-85. Microwaves are used in radars why?

Ans: The wavelength of microwaves are short. Hence these are used in rador systems which are used in aircraft navigation.

Q-86. Give two uses of infrared rays?

Ans: 1. To take photographs in fog 2. In physiotherapy

3. In both for military purpose and to observe growth of crops.

Semi Conductor Electronics

Q-87. What is a n-type semi conductor? What are the majority & Minority charge carries in it?

Ans: n-type semiconductor:- The semiconductor formed by doping pentavalent element to it, is called n-type semiconductor, Electrons are the majority charge carriers and holes are minority charge carriers in it.

Q-88. What is intrinsic and extrinsic semiconductors?

Ans: Intrinsic Semiconductor: Pure semiconductors are called intrinsic semiconductors ex:- Ge, Si etc.

Extrinsic semiconductors: The semiconductors doped with impurity care called extrinsic semiconductors Ex:- P-type and n-type.

Q-89. What is P -type semiconductor? What are the majority and minority charge carriers in it?

Ans: P-Type semiconductor : When trivalent impurity is added to a pure semiconductor then it is called P-Type semiconductor.

Majority charge carriers: In n-type semiconductor majority charge carriers are holes.

Minority charge carriers :- In P-tyype semiconductor minority charge carriers are electrons.

Q-90. What is a P-n junction diode? Define depletion layer?

Ans: P-n Junction diode:- When P - type and n-type semiconductor are separated by junction and it is has two terminal is called p-n junction diode.

Depletion layer:- A region without any charge carriers are formed a p-n junction due to the recombination of electrons and holes is called depletion layer.

Q-91. How is a battery connected to a junction diode in 1) forward and 2) reverse biase?

Ans : P-region is connected to positive terminal of a battery and n-region is connected to negetive terminal of a battery. Then it is called forward biase. The current will be an order of few milli amperes.

Reverse Biase:- P-Region is connected to negative terminal of a battery and n-region is connected to a positive terminal of a battery. Then it is called reverse biase.

Q-92. What is maxmum percentage of rectification in half wave and full wave rectifiers?

Ans:-

1. Maximum efficiency of half-wave rectifier is 40.6%
2. Maximum efficiency of full - wave rectifier is 81.2%

Q-93. What is zener voltage (V_Z) and how will a zener diode be connected in circuits generally?

Ans: Zener voltage:- In a p-n junction diode in the reverse biase current increases suddenly due to the rupture (breakage) of co-valent bonds. This break down voltage is called Zener voltage.

A Zener diode is connected in circuits in reverse bias.

Q-94. Write the expressions for efficiency of a full wave rectifier and half wave rectifier.

Ans: 1 for full-wave rectifier, efficiency

$$n = \frac{0.812RL}{rf + RL}$$

2. For half-wave rectifier, efficiency

$$n = \frac{0.406RL}{rf + RL}$$

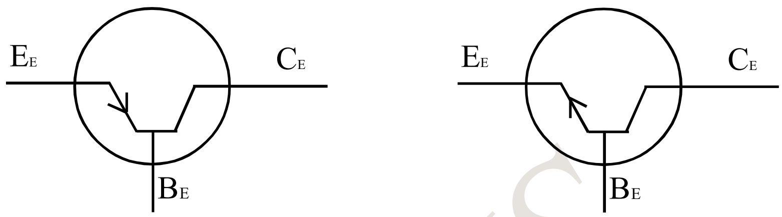
Where rf= forward resistance of diode and RL = load resistance.

Q-95. What happens to width of the depletion layer in a P-n junction diode when its
1) forward biased
2) reverse biased

Ans: 1. In forward bias condition, width of depletion layer decreases.
2. In reverse bias condition, width of depletion layer increases.

Q-96. Draw the circuit symbols for P-N-P and N-P-N transitors?

Ans: The symbols of P-N-P and N-P-N transittor are given below:-



P-N-P Transitor　　N-P-N Transitor

Q-97. In which bias a zemer diode can be used as voltage regulator?

Ans: Zener diode can be used as a voltage. regulator by operating it in the breakdown region in reverse bias condtion.

Q-98. Define amplifier and amplification factor?

Ans: Amplifier: Amplifier is a device used to raise the strength of weak signals.
Amplification factor:- Amplification factor is the ratio between output to the input voltage

$$A = \frac{\Delta VcE}{\Delta VBE}$$

Q-99. Which gates are called universal Gates?

Ans: NAND gate and NOR gate are known as the basic building blocks of logic gates or universal gates.
Because any logic gate can be constructed by using only NAND gates or NOR gates.

Q-100. Write the truth table of NAND gate. How does it differ from AND gate.

Ans:

1. NAND gate:-

A	B	Y=A.B
O	O	1
1	O	1
O	1	1
1	1	O

2. AND gate:-

A	B	Y=A.B
O	O	O
1	O	O
O	I	O
1	1	1

Communication Systems

Q-101. What are the basic blocks of a communication system

Ans: Basic blocks of commuunication system are

1) Transmitter 2) Transmission channel 3) Receiver

Q-102. What is world wide web (WWW)?

Ans: A world wide web (WWW): WWW may be regarded as the encylopedia of knowledge accessible to every round the clock throughout the year.

Tim berners - Lee invented the world wide web.

Q-103. Mention the frequency range of speech signals?

Ans: For speech signals, the adequate frequency range is between 300HZ and 3100 HZ speech signals require a bandwidth of 2800 HZ.

Q-104. What is sky wave propogation.

Ans: Long distance short wave communication is possible by ionosphere reflection called sky wave propogation. is used in the inosphere frequency ranges from few MHz to about 30 MHz

Q-105. Mention the various parts of ionosphere.

Ans: Different parts of ionosphere

S.No.	Name of the layer	Height over earths surface
1	Part of stratosphere (D)	65-75 km
2	Part of stratosphere (F)	100 km
3	Part of mesosphere (F1)	170 -190 km
4	Thermosphere (F2)	300 km at night, 250-400 km during day time

Q-106. Define modulation. Why is it necessary?

A) Modulation:-

The Process of combining audio frequency (low frequency) signal with high frequency signal is called modulation. modulation is neccessary for the following reasons.

1) to reduce the size of antenna
2) to increase the effective power radiated by antenna.
3) to avoid the mixing up of signals from different transmitters.

Q-107. Mention the basic methods of modulation?

A The basic methods of modulation are?

1) amplitude modulation (AM).
2) Frequency modulation (FM) and
3) Phase Modulation (PM)

Q-108. Which type of communication is employed in mobile phones?

Ans: The mobile phones space wave communication is used.

*******The End*******